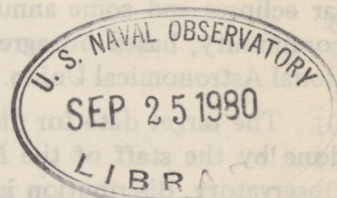


UNITED STATES NAVAL OBSERVATORY

C I R C U L A R N O. 1 6 0

U. S. Naval Observatory, Washington, D. C. 20390

July 4, 1980



TOTAL SOLAR ECLIPSE OF 31 JULY 1981

by

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and

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UNITED STATES NAVAL OBSERVATORY
CIRCULAR NO. 100

It is a continuing policy of the Nautical Almanac Office to prepare issues of the series of Naval Observatory *Circulars* containing detailed information for observing most total solar eclipses and some annular solar eclipses. This is a service to the international scientific community, based on agreements with Commissions and Working Groups of the International Astronomical Union.

The target date for distribution is one year in advance of the event. The distribution is done by the staff of the Nautical Almanac Office. As a regular publication of the Naval Observatory, distribution is made to institutions with which the Observatory has exchange agreements or other obligation. No other mailing list or request file is maintained. Users must make a new written request for each eclipse Circular, no more than 12-14 months in advance. There is no charge for a single copy; bulk rates will be quoted upon written request to the Director of the Nautical Almanac Office.

The content and layout of the eclipse Circulars is being reviewed and revised. Users' comments are solicited, on useful features to be continued as well as suggestions for changes or additions.

It is permissible to reproduce any portion of this *Circular*. It is requested that when any information herein is used for any purpose that an appropriate acknowledgment of the source be made.

Alan D. Fiala
and
Marie R. Lukac

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GENERAL INFORMATION

A total eclipse of the Sun will occur on Friday, 31 July 1981. The last preceding total eclipse of the Sun was on 16 February 1980, when the path crossed central Africa, India, Burma, and the Peoples' Republic of China. The next total eclipse of the Sun will occur on 11 June 1983, when the path will cross Indonesia. The preceding eclipse in the same saros was the total of 20 July 1963, across Canada and the northeastern United States. The next in the saros is the total of 11 August 1999, across Europe, the Middle East, and India. This solar eclipse will be preceded by an associated partial eclipse of the Moon on 17 July 1981.

PATH AND VISIBILITY. The portion of the path of totality over land will lie entirely in the U.S.S.R. At approximately 02h 18m UT on 31 July 1981, the center of the umbra of the Moon's shadow will first touch the Earth at sunrise in the southeast end of the Black Sea, beginning the path of total phase. The path will be approximately 40 miles wide, and the duration of totality will be approximately 44 seconds. Proceeding eastward and northward across the Caucasus Mountains, the path will graze the flank of Mt. Elbrus. Then it will continue across the northern end of the Caspian Sea, but will not include the north coast. Up to this point, the total phase will occur early enough in the morning that the Sun will be seen to rise in partial eclipse. East of the Caspian Sea, first contact will occur after sunrise. The path of totality will continue east and north across the Kirghiz Steppes and the southernmost end of the Urals. After crossing northern Kazakh S.S.R., passing just north of Tselinograd, the path will pass through Western Siberia in the southernmost extension, between Novosibirsk and Barnaul. Beyond that, Leninsk-Kuznetskiy and Belovo lie in the path. Further northeast in a little higher country, Bratsk lies near the north edge in the path. Less than one hour will have passed since first contact with the Earth, and the path will be 65 miles wide, with a duration of approximately 1m 51s at the center line. Going nearly due east, the southern limit of totality will graze across the north end of Lake Baykal. This will mark the most northerly section of the path; from here it will curve back to the south and east. The path will continue over relatively unpopulated mountainous territory until it reaches the Pacific Coast. Just before that, the maximum path width of 69 miles and maximum duration at the center of 2m 6s will have been attained, at approximately 3h 45m UT. Emerging onto the east coast just south of Nikolayevsk-na-Amure, the path will cross the Tatar Strait, north central Sakhalin at Aleksandrovsk, then head southeast across the Sea of Okhotsk. The last bit of land in the path will be three of the Kuril Islands. Thus the entire land portion of the path will be in the U.S.S.R.; the rest of the path is to the southeast over the Pacific Ocean. The umbra will leave the earth at sunset to the northwest of Hawaii at approximately 5h 13m UT, with the path width once again being 40 miles, the duration 46 seconds.

Partial phases of the eclipse, of magnitude decreasing with the distance from the path of total phase, will be visible over all Asia except the southeastern peninsula and the south of India; most of the Middle East; northeastern Europe; Scandinavia; most of Greenland; Alaska and Hawaii; northwestern Canada; and the northwest quadrant of the Pacific Ocean (see the overall map following this section). The Sun will rise in partial eclipse as seen from eastern Europe, the Middle East, and western U.S.S.R. It will set in partial eclipse as seen from Hawaii, the central Pacific Ocean, and portions of northwest Canada.

PARAMETERS. The predictions in this *Circular* are derived from the solar and lunar data published in the *Astronomical Almanac for the Year 1981*. The arguments are in Universal Time, using $\Delta T = 52^s.29$ to interpolate the solar ephemeris and $\Delta T = 50^s.95$ to interpolate the $j=2$ lunar ephemeris. This incorporates a correction of $-1^s.34$ to refer the lunar ephemeris more nearly to the same equinox as the solar ephemeris. Continuing the practice begun in 1980, no correction was applied to the tabular latitude of the Moon to try to correct for the difference between center of mass and center of figure. Observers who wish to allow for this generally prefer to apply their own correction. The ratio of the Moon's radius to the Earth's equatorial radius was taken to be $k=0.2724880$, except that in calculating duration on the central line for altitudes above sea level, $k=0.272281$ was used by way of applying an approximate correction for the irregularities of the lunar limb.

DEFINITIONS OF TERMS.

Time arguments are Universal Time, as described above.

Longitudes are negative east of Greenwich, positive west of Greenwich.

First and fourth contacts are, respectively, the beginning and the end of the partial phase. *Second and third contacts* are, respectively, the beginning and the end of the total phase, if it occurs at the location given. *Duration* is the time interval between second and third contacts. Dot leaders indicate that a phenomenon occurs below the horizon for the given location.

The *position angle* of a point of contact on the solar limb is measured eastward (counterclockwise) around the solar limb. P is the position angle measured from the north point of the limb; V is the position angle measured from the vertex point. The north point lies on the great circle arc drawn from the north celestial pole to the center of the solar disk; the vertex lies on the great circle arc drawn from the zenith to the center of the solar disk.

The *azimuth* of the Sun is measured along the horizon clockwise from the north point eastward to the foot of the great circle arc drawn from the zenith through the center of the solar disk down to the horizon.

The *magnitude* of the eclipse is by definition the fraction of the apparent diameter of the solar disk covered by the Moon at the time of greatest phase, expressed in units of the solar diameter. For partial phase at maximum eclipse (no totality), the magnitude is less than 1. For total phase at maximum eclipse, the magnitude is the diameter of the Moon's disk in units of the solar diameter.

Degree of *obscuration*, prepared especially for this *Circular*, is the fraction (per cent) of the area of the apparent solar disk obscured by the Moon at maximum eclipse. Numerically, it is always less than the magnitude. For a few points near the edge of the path of totality, rounding and neglect of altitude may indicate total obscuration for points predicted to be outside the path.

Inexperienced observers are cautioned that at anything less than total obscuration, even 99%, the Sun should not be observed directly without safe filters. A projected image is preferable.

LOCAL CIRCUMSTANCES. (Contact Times)

A table of accurate local circumstances for a list of geographic locations is provided in this *Circular*. These are tabulated by country, most of them being in the U.S.S.R. in or near the path of totality. For the most part, the coordinates were read from the maps and calculations were carried out for mean sea level. An elevation of several hundred meters may change the times by as much as a second and shift the path a few hundred meters. The printed circumstances correspond to the printed coordinates, in case there should be an error in identification.

For the user who wishes to calculate his own local circumstances, the elements of conjunction, general circumstances, and Besselian Elements for Universal Time arguments and without the latitude correction for the Moon are presented. The Besselian Elements are given as usual in tabular form, and also for the first time in polynomial form, courtesy of Mr. L. E. Doggett. Precepts for the calculations of local circumstances may be found in the Explanation of a recent *American Ephemeris* or *Astronomical Almanac*.

For a location not specifically listed, the contact times can be estimated to within a few minutes from the maps and tables in this *Circular*.

Beginning and end of the partial phase, or first and last contacts, can be estimated using the overall map reproduced from the *Astronomical Almanac*. Starting in 1981, this map displays the same type of curve as was customarily shown before 1960. The dashed lines show the surface outline of the Moon's penumbra at a time interval of 30 minutes. The short dashes show the leading edge, the long dashes show the trailing edge. First contact occurs when the leading edge passes over the location in question, last contact occurs when the trailing edge passes. Duration is the time difference between contacts. The time halfway between is the middle of the eclipse. This is near the time of maximum eclipse, but not necessarily identical. For a given geographic location, one need only estimate the intermediate position of the penumbra's edge between the starting and ending lines on either side and thus the time of the contact. For observers within the elongated teardrop curves to the extreme east and west, part of the eclipse occurs below the horizon.

Low precision times of second and third contacts in the path of totality can also be estimated. The path of total phase over land is shown on a series of detail maps in the last part of this *Circular*. Preceding the maps is a table of Local Circumstances for Points on the Central Line, pp. 18–19. On the maps, the heavy solid lines mark the northern and southern limits and central line of the predicted path. Each dashed line represents the projection of the diameter of the umbra, joining the northern and southern limits and central point for the indicated instant—at which all points on the dashed line observe maximum eclipse.

Use the maps and the table as follows: Find on the maps the location in the path for which you want local circumstances. Through this point draw a line across the path parallel to the dashed lines. Mark the point where this line intersects the central line. Measure the length (m_1) of the segment of the central line between the preceding and following minute points. Measure the length (m_2) of the central line between the preceding minute point and the line you drew in. The ratio (m_2/m_1) gives the fraction of a minute to be added to the preceding time, thus giving the time of maximum eclipse for the selected location. Call this time t_0 . Now turn to the Table of Local Circumstances for Points on the Central Line. This is a two

page spread, left hand page and right hand page. The first column on each page is the Universal Time at which maximum eclipse occurs for the point on the central line whose coordinates are given in the second and third columns on the left hand page. Take the time (t_0) computed above, and find the two lines in the table whose times bracket it. Using the appropriate fraction of the time interval, interpolate the time of second contact from the left hand page, and from the right hand page interpolate the time of third contact, the duration (D), and the width of path. Now go back to the map. Mark the points on the central line corresponding to second and third contact times to get an estimate of the breadth of the projected shadow. On the line previously drawn across the path, measure the length (a) from the center of the path to the edge. In the same fashion measure the length (b) from the center of the path to the selected location. Next compute the approximate duration (T) for the selected location by $T = D \sqrt{1 - (b/a)^2}$. Then the time of second contact is approximately $t_0 - T/2$, and the time of third contact is approximately $t_0 + T/2$.

LOCAL CIRCUMSTANCES. (Position Angles and Limb Corrections)

The appropriate profile for this eclipse is reproduced from *Circular No. 141*. For locations in the path of totality, the predicted times and position angles of contacts are based on the Moon's mean limb (the dashed circle). The limb profile allows an observer to estimate the correction to allow for limb irregularities.

In working with this construction, remember that position angles are given for the solar disk, which is observable, but corrections are based on features on the lunar disk, shown in the diagram. The two nearly coincide between second and third contacts, so it is adequate to plot angles pertaining to the Sun on the lunar diagram. However, this is not the case for first and fourth contacts.

To attain maximum accuracy, one must sketch in an arc of the solar limb at the predicted contact point, but deformed from a circle according to the radial scale for limb features. You may also find it convenient to use a transparent overlay with a circle of radius three inches.

For each second or third contact to be sketched, take from the tables the time of contact (t_c), the angles P and V , and the altitude (a) and azimuth (A) of the Sun at maximum eclipse. Convert the time of contact to hours and decimals of an hour. Also, (a) is not the same quantity as in the previous section. Compute the angle C from the following equation, in which all numerical quantities are degrees:

$$C = 15.72 + 0.17t_c - 0.33 \sin(90 - a) \sin(P - V).$$

(If C is negative, you may add 360.)

On the diagram, N marks the lunar meridian containing the north pole of the Moon's rotation. Using the four direction tick marks, find the center of the circle. Draw a line from the center through N . The north point of the disk is the point nearby on the limb intersected by the projection onto the disk of the observer's meridian. To find this, measure an angle C westward (clockwise) from N . Mark the point on the mean limb and draw a line from the center through it. This points to the north celestial pole. Now measure from this line back an angle P eastward (counterclockwise) to find the point of contact on the mean limb. Draw a line from the center out through that point. Finally, from that line, measure through the angle V westward (clockwise) to find the direction of the observer's zenith. Draw a line from the center of the circle out through this point. This line points to the zenith. Now you can visualize events as follows: Face in the direction of the Sun's azimuth (A) at maximum eclipse (measured in degrees from the north point of the horizon around clockwise to the east), hold the diagram up at arm's length at the altitude (a) of the Sun at maximum eclipse, and turn it so that the line pointing to the zenith points straight up. The line to the north point of the disk will point to the celestial north pole for the observing site, and the point of contact at the limb will be at its correct apparent orientation as seen visually.

At the points of contact, inspection of the profile will reveal whether the Sun is actually covered or not and whether there are peaks or valleys which can create Bailey's Beads. The Moon is gaining on the Sun at just under 0.6 seconds of arc per second of time (see *Elements of the Eclipse*). Measuring the difference between the mean and true limbs at the contact point and comparing it to the scale segment will allow an estimate of the time correction to be applied.

To get position angles for locations not listed in the table of Local Circumstances for Geographic Locations, follow the directions above and plot the points of second and third contacts for the interpolated location *on the center line*. In the process, be sure to mark the directions to the north point and the zenith. Draw the chord (straight line) connecting the two contacts on the mean limb. It should pass through the center of the disk. Next, draw or construct a perpendicular diameter. At its two points of intersection with the mean limb, construct lines perpendicular to it which are tangent to the limb and parallel to each other and to the first diameter joining the contact points. This set of 3 parallel lines represents a projection of the path corresponding to the one on the maps.

Note from the map whether the chosen observing location is north or south of the center line. Taking (b/a) from the earlier calculation of duration, and measuring along the diameter which is perpendicular to the three parallel lines, measure off (b/a) $\times$ radius from the center of the circle, toward the north or south side as appropriate. Mark the point on the diameter, and there draw or construct a perpendicular line which is then another parallel to the 3 lines representing the path. This new parallel line will intersect the mean limb at approximately the points of contact. The eastern point is for second contact, the western is for third contact. They should be expected to be a few degrees different from a full calculation, but adequate for field estimates.

ACKNOWLEDGMENTS. The path of total phase over land was prepared by Nautical Almanac Office staff members Linda Gardner and Marie Lukac under the supervision of Alan Fiala. It is presented on portions of Operational Navigation Charts (ONC) F-4, F-5, E-5, E-6, E-7, E-8, E-9, E-10, F-11, scale 1:1,000,000, Lambert Conformal Conic Projection. These maps are a product of Defense Mapping Agency Aerospace Center. The map portions in this *Circular* are reduced to 60% of original size, enlarging the scale from 15.78 mi/inch to 26.3 mi/inch. The overall map was also prepared by Ms. Lukac.

The Limb Profile chart is from *U. S. Naval Observatory Circular No. 141*, "Lunar Limb Profiles for Solar Eclipses," by Julena S. Duncombe, March 16, 1973.

The polynomial representation of the Besselian Elements was contributed by Mr. Leroy E. Doggett, Nautical Almanac Office.

The climatological information was reviewed by Prof. Paul E. Lydolph, University of Wisconsin, Milwaukee. It is extracted from his book *Climates of the Soviet Union*, World Survey of Climatology, Vol. 7, Elsevier Scientific Publishing Co., 1977. His personal comments were very helpful.

All other material in this publication was prepared by Alan Fiala, upon whom final responsibility rests for the entire contents. He also prepared the text and headings, using an IBM Mag Card Composer. The text is 8-pt. Century Expanded, the headings are Univers Condensed.

OBSERVATIONS. Precise observations of contact times, at any part of the path, are needed and requested. However, precise coordinates of the place of observation are necessary. Please report the details of such observations to

Nautical Almanac Office
U. S. Naval Observatory
Washington, D. C. 20390

FURTHER INFORMATION. Inquiries concerning local circumstances and the path may be directed to the Nautical Almanac Office.

The Astronomical Council of the U.S.S.R. Academy of Sciences has appointed a special committee to supply information and handle arrangements for observing. The President of the Committee is

Prof. Vladimir A. Krat
Central Astronomical Observatory of the
U.S.S.R. Academy of Sciences at Pulkovo
Leningrad M-140, U.S.S.R.

Also,

Mrs. Dr. Anne B. Delaunay
The Solar Department
Sternberg State Astronomical Institute
Moscow B-234, 117234 U.S.S.R.

expects to have published a meteorological bulletin in the *Pis'ma v Astronomicheskij Zhurnal* or the *Astronomicheskij Zhurnal* itself.

ELEMENTS OF THE ECLIPSE

U.T. of geocentric conjunction in right ascension, July 31^d03^h35^m33^s.561
 Julian Day No. 2444816.649693988

	h	m	s		s
Right Ascension of Sun	8	41	01.584	Hourly motion	9.741
Right Ascension of Moon	8	41	01.584	Hourly motion	145.026
ΔT for solar ephemeris			+52.29		
ΔT for lunar ephemeris			+50.95		
	°	'	"		'
Declination of Sun	+18	18	31.19	Hourly motion	- 0 36.89
Declination of Moon	+18	52	47.50	Hourly motion	- 5 49.86
Equatorial hor. par. of Sun			8.66	True semidiameter of Sun	15 45.4
Equatorial hor. par. of Moon			58 32.86	True semidiameter of Moon	15 57.2

CIRCUMSTANCES OF THE ECLIPSE

	U. T.	Longitude	Latitude
	d h m	° '	° '
Eclipse begins	July 31 01 11.3	- 62 53.5	+29 39.5
Central eclipse begins	31 02 17.8	- 39 46.0	+42 01.5
Central eclipse at local apparent noon	31 03 35.6	-127 41.4	+54 30.9
Central eclipse ends	31 05 13.8	+158 03.4	+24 52.6
Eclipse ends	31 06 20.4	+179 25.8	+12 11.3

BESSELIAN ELEMENTS, POLYNOMIAL FORM

The equations below represent a simple least-squares polynomial fit to the tabular Besselian Elements. Do not use T outside the given range, and do not omit any terms in the series.

Let T be the Universal Time in hours, such that $1^{\text{h}}.083 \leq T \leq 6^{\text{h}}.900$, i.e., $1^{\text{h}} 05^{\text{m}} - 6^{\text{h}} 54^{\text{m}}$.

$$\begin{aligned}
 x &= -1.96874328 + 0.54790626 T + 0.00005309 T^2 - 0.00000822 T^3, \text{ Error} < 2 \times 10^{-6} \\
 y &= +0.90489610 - 0.08798356 T - 0.00015733 T^2 + 0.00000134 T^3, \text{ Error} \leq 1 \times 10^{-6} \\
 \sin d &= +0.31470985 - 0.00016630 T, \text{ Error} \leq 1 \times 10^{-6} \\
 \cos d &= +0.94918811 + 0.00005501 T, \text{ Error} \leq 1 \times 10^{-6} \\
 \mu &= 178.4128692 + 15.0018573 T + 0.0000021 T^2, \text{ Error} \leq 1 \times 10^{-5} \\
 \text{Radius Penumbra} &= +0.54236538 + 0.00020355 T - 0.00001156 T^2, \text{ Error} \leq 1 \times 10^{-6} \\
 \text{Radius Umbra} &= -0.00396130 + 0.00020268 T - 0.00001153 T^2, \text{ Error} \leq 1 \times 10^{-6}
 \end{aligned}$$

OTHER BRIGHT OBJECTS

Object	Elongation (Degrees)	Magnitude	Object	Elongation (Degrees)	Magnitude
Mercury	W. 10	1.2	Saturn	E. 58	1.2
Venus	E. 30	-3.4	Regulus	E. 21	1.3
Mars	W. 29	1.8	Pollux	W. 14 (north)	1.2
Jupiter	E. 58	-1.4	Procyon	W. 15 (south)	0.5

CLIMATOLOGICAL INFORMATION

The path of totality will cut across several weather and climate zones. The beginning part, in the Caucasus between the Black Sea and the Caspian Sea, is generally sunny in the summer. However, the part west of the mountains is perhaps less so than the others. East of the mountains, flat plains extend to the Caspian Sea. Beyond that in north central Kazakhstan begins semidesert and grassland steppes. July is the hottest and clearest period of the year, but dust storms may occur.

Further east, beyond Novosibirsk, the path will cross rolling plateau, then north of a long stretch of rugged mountains in southeastern Siberia. Around Lake Baykal the weather is affected by the mass of water. There is frequent fog, particularly at the north end.

On the Pacific coast there may still be ice floes in the Sea of Okhotsk. Warm moist air coming from the Pacific creates much precipitation and fog.

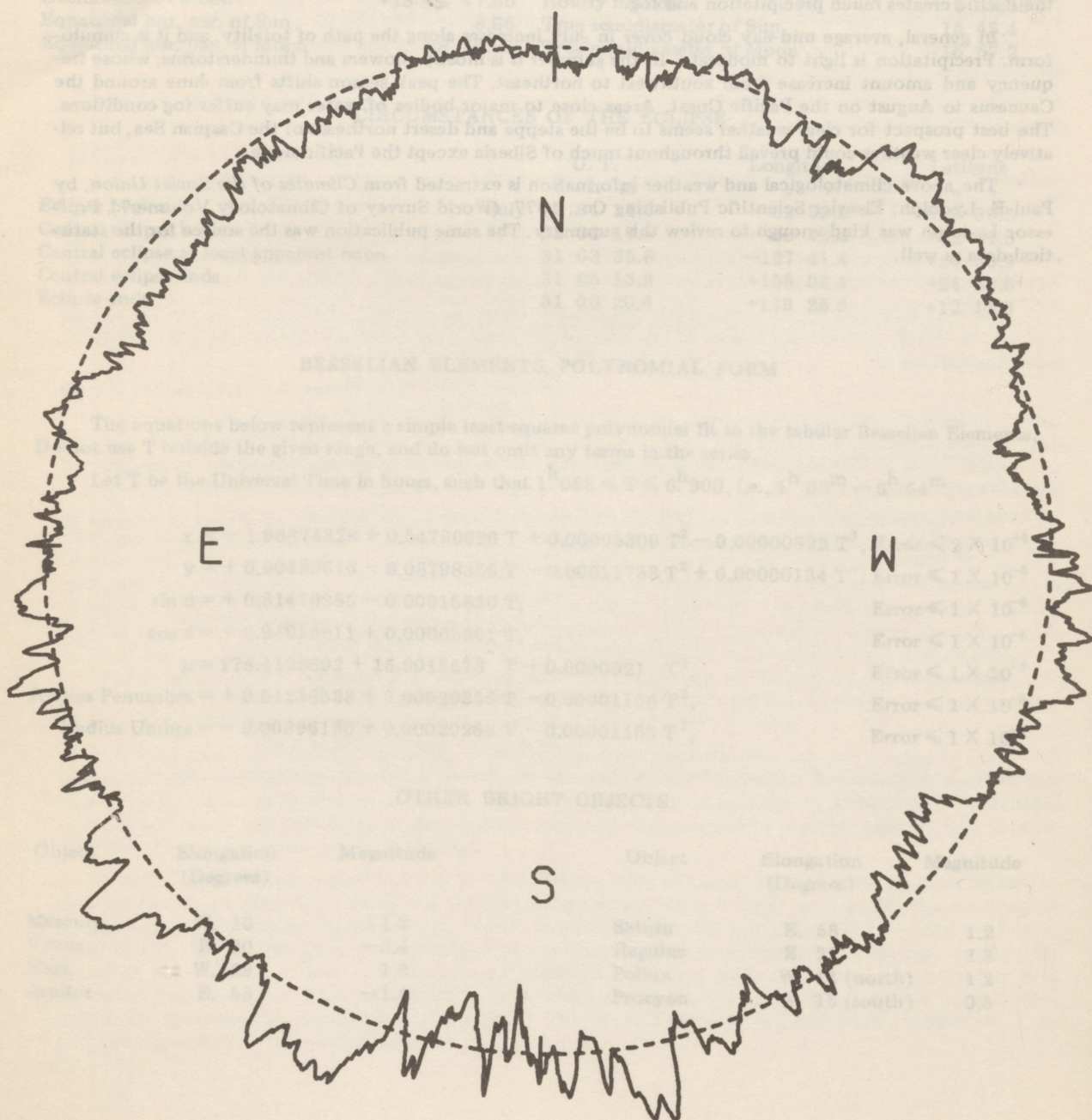
In general, average mid-day cloud cover in July increases along the path of totality, and it is cumuloform. Precipitation is light to moderate. In the summer it is mostly showers and thunderstorms, whose frequency and amount increase from southwest to northeast. The peak season shifts from June around the Caucasus to August on the Pacific Coast. Areas close to major bodies of water may suffer fog conditions. The best prospect for clear weather seems to be the steppe and desert northeast of the Caspian Sea, but relatively clear weather could prevail throughout much of Siberia except the Pacific slope.

The above climatological and weather information is extracted from *Climates of the Soviet Union*, by Paul E. Lydolph; Elsevier Scientific Publishing Co., 1977. (World Survey of Climatology Volume 7). Professor Lydolph was kind enough to review this summary. The same publication was the source for the statistical data as well.

LUNAR LIMB PROFILE

L=+5°00 B=0°00

RADIAL SCALE: 1 SECOND OF ARC = 
DOTTED LINE = MEAN LIMB SOLID LINE = TRUE LIMB



TOTAL SOLAR ECLIPSE OF 31 JULY 1981

11

BESSELIAN ELEMENTS

U.T. h m	Intersection of Axis of Shadow with Fundamental Plane		Direction of Axis of Shadow			Radius of Shadow on Fundamental Plane	
	<i>x</i>	<i>y</i>	<i>sin d</i>	<i>cos d</i>	μ °	Penumbra	Umbra
1 10	-1.329460	+0.802036	+0.314515	0.949252	195.91504	0.542587	-0.003741
20	1.238126	0.787308	.314488	.949262	198.41535	.542616	.003712
30	1.146792	0.772571	.314460	.949271	200.91566	.542645	.003683
40	1.055457	0.757826	.314433	.949280	203.41597	.542673	.003656
50	0.964121	0.743073	.314405	.949289	205.91628	.542700	.003628
2 00	-0.872785	+0.728311	+0.314377	0.949298	208.41659	0.542726	-0.003602
10	0.781448	0.713541	.314350	.949307	210.91690	.542752	.003576
20	0.690112	0.698762	.314322	.949316	213.41721	.542777	.003551
30	0.598775	0.683975	.314294	.949326	215.91752	.542802	.003527
40	0.507439	0.669180	.314266	.949335	218.41784	.542826	.003503
50	0.416103	0.654377	.314239	.949344	220.91815	.542849	.003480
3 00	-0.324768	+0.639565	+0.314211	0.949353	223.41846	0.542872	-0.003457
10	0.233435	0.624746	.314183	.949362	225.91877	.542894	.003435
20	0.142103	0.609919	.314156	.949371	228.41908	.542915	.003414
30	-0.050773	0.595084	.314128	.949381	230.91940	.542936	.003393
40	+0.040556	0.580241	.314100	.949390	233.41971	.542956	.003373
50	0.131882	0.565390	.314073	.949399	235.92002	.542976	.003354
4 00	+0.223206	+0.550531	+0.314045	0.949408	238.42033	0.542995	-0.003335
10	0.314527	0.535664	.314017	.949417	240.92065	.543013	.003317
20	0.405845	0.520789	.313989	.949426	243.42096	.543030	.003299
30	0.497160	0.505907	.313962	.949436	245.92127	.543047	.003283
40	0.588472	0.491016	.313934	.949445	248.42158	.543064	.003266
50	0.679781	0.476118	.313906	.949454	250.92189	.543079	.003251
5 00	+0.771086	+0.461213	+0.313879	0.949463	253.42221	0.543094	-0.003236
10	0.862387	0.446299	.313851	.949472	255.92252	.543108	.003222
20	0.953685	0.431379	.313823	.949481	258.42283	.543122	.003208
30	1.044978	0.416451	.313795	.949491	260.92315	.543135	.003195
40	1.136267	0.401515	.313768	.949500	263.42346	.543147	.003183
50	1.227551	0.386572	.313740	.949509	265.92378	.543159	.003171
6 00	+1.318831	+0.371621	+0.313712	0.949518	268.42409	0.543170	-0.003160
10	1.410104	0.356663	.313684	.949527	270.92440	.543181	.003150
20	1.501371	0.341697	.313656	.949537	273.42472	.543191	.003140
30	1.592632	0.326724	.313629	.949546	275.92503	.543200	.003131
40	1.683888	0.311744	.313601	.949555	278.42534	.543208	.003122
50	+1.775137	+0.296756	+0.313573	0.949564	280.92566	0.543216	-0.003114

$\tan f_1$ 0.004606
 $\tan f_2$ 0.004583
 μ' 0.261832 radians per hour
 d' -0.000175 radians per hour

TOTAL SOLAR ECLIPSE OF 1981 JULY 31



PATH OF THE TOTAL PHASE

Universal Time h m Limit	Northern Limit		Central Line		Southern Limit	
	Latitude	Longitude	Latitude	Longitude	Latitude	Longitude
	° ' "	° ' "	° ' "	° ' "	° ' "	° ' "
	+42 15	- 39 33	+42 02	- 39 46	+41 48	- 39 59
2 18	.. ..	... ..	+43 18.2	- 43 27.6	+43 55.5	- 46 15.9
19	+44 57.4	- 47 18.0	45 12.7	49 05.6	45 23.3	50 42.6
2 20	+46 13.1	- 51 02.2	+46 18.9	- 52 27.1	+46 22.3	- 53 47.4
22	47 54.4	56 15.0	47 52.4	57 23.7	47 49.0	58 30.3
24	49 08.4	60 16.5	49 02.1	61 18.0	48 54.9	62 17.9
26	50 08.2	63 42.7	49 58.9	64 39.7	49 48.9	65 35.3
28	50 58.6	66 47.2	50 47.0	67 40.8	50 34.8	68 33.2
2 30	+51 42.2	- 69 36.5	+51 28.7	- 70 27.4	+51 14.7	- 71 17.2
35	53 09.9	75 56.3	52 52.6	76 41.8	52 34.9	77 26.2
40	54 15.8	81 35.9	53 55.6	82 16.6	53 35.1	82 56.2
45	55 05.6	86 49.3	54 43.1	87 25.4	54 20.2	88 00.5
50	55 42.6	91 43.8	55 18.1	92 15.3	54 53.4	92 45.7
55	56 08.7	96 23.3	55 42.6	96 50.1	55 16.4	97 15.9
3 00	+56 25.4	-100 50.3	+55 58.0	-101 12.3	+55 30.6	-101 33.4
05	56 33.6	105 06.3	56 05.3	105 23.4	55 36.9	105 39.9
10	56 34.3	109 12.1	56 05.3	109 24.5	55 36.2	109 36.4
15	56 28.0	113 08.5	55 58.5	113 16.3	55 29.0	113 23.6
20	56 15.4	116 55.9	55 45.6	116 59.2	55 15.8	117 02.2
25	55 56.9	120 34.8	55 27.0	120 33.8	54 57.2	120 32.6
3 30	+55 32.9	-124 05.5	+55 03.2	*-124 00.4	+54 33.4	-123 55.3
35	55 03.8	127 28.5	54 34.4	127 19.6	54 04.9	127 10.9
40	54 30.0	130 44.1	54 00.9	130 31.8	53 31.9	130 19.6
45	53 51.6	133 53.0	53 23.1	133 37.4	52 54.6	133 22.2
50	53 09.0	136 55.6	52 41.2	136 37.1	52 13.3	136 19.1
55	52 22.3	139 52.5	51 55.3	139 31.5	51 28.1	139 10.9
4 00	+51 31.7	-142 44.5	+51 05.5	-142 21.1	+50 39.2	-141 58.3
05	50 37.2	145 32.2	50 12.0	145 06.8	49 46.6	144 41.9
10	49 38.9	148 16.5	49 14.7	147 49.3	48 50.3	147 22.6
15	48 36.8	150 58.2	48 13.7	150 29.5	47 50.4	150 01.2
20	47 30.9	153 38.5	47 08.9	153 08.3	46 46.7	152 38.7
25	46 20.9	156 18.4	46 00.1	155 47.1	45 39.1	155 16.2
4 30	+45 06.6	-158 59.4	+44 47.1	-158 27.0	+44 27.4	-157 55.1
35	43 47.7	161 43.2	43 29.5	161 09.8	43 11.1	160 36.9
40	42 23.5	164 31.8	42 06.8	163 57.5	41 49.8	163 23.7
45	40 53.2	167 28.2	40 38.1	166 53.1	40 22.6	166 18.3
50	39 15.6	170 36.4	39 02.2	170 00.3	38 48.4	169 24.5
55	37 28.4	174 02.6	37 17.0	173 25.2	37 05.2	172 48.2
5 00	+35 28.1	-177 57.5	+35 19.1	-177 18.3	+35 09.7	-176 39.5
02	34 34.9	-179 43.7	34 27.0	-179 03.4	34 18.7	-178 23.5
04	33 37.6	+178 19.9	33 31.0	+179 01.7	33 24.0	+179 42.9
06	32 34.9	176 09.6	32 29.9	176 53.4	32 24.5	177 36.6
08	31 24.5	173 38.9	31 21.7	174 25.9	31 18.3	175 12.1
5 10	+30 01.9	+170 34.3	+30 02.3	+171 27.1	+30 01.8	+172 18.5
11	29 12.7	168 39.9	29 15.6	169 37.9	29 17.3	170 33.9
12	28 13.5	166 17.0	28 20.6	167 24.8	28 25.8	168 28.7
13	+26 50.5	+162 45.3	+27 08.5	+164 21.5	27 21.2	165 44.6
14	.. ..	... ..	.. ..	... ..	25 24.9	160 25.9
Limit	+25 05	+157 54	+24 53	+158 03	+24 40	+158 13

TOTAL SOLAR ECLIPSE OF 31 JULY 1981

CENTRAL LINE OF TOTAL PHASE

Universal Time	10,000 Feet				20,000 Feet				30,000 Feet				40,000 Feet			
	Latitude		Longitude		Latitude		Longitude		Latitude		Longitude		Latitude		Longitude	
	°	'	°	'	°	'	°	'	°	'	°	'	°	'	°	'
2 18	+43	29.1	-	44 04.1	+43	38.5	-	44 36.3	+43	46.9	-	45 05.6	+43	54.5	-	45 32.5
19	45	16.5	49	21.8	45	20.2	49	37.7	45	23.7	49	53.2	45	27.1	50	08.3
2 20	+46	21.3	-	52 39.4	+46	23.6	-	52 51.7	+46	25.9	-	53 03.7	+46	28.2	-	53 15.6
22	47	53.6	57	33.0	47	54.9	57	42.3	47	56.1	57	51.5	47	57.4	58	00.6
24	49	02.9	61	25.8	49	03.6	61	33.6	49	04.3	61	41.4	49	05.0	61	49.1
26	49	59.3	64	46.6	49	59.7	64	53.5	50	00.1	65	00.4	50	00.4	65	07.3
28	50	47.2	67	47.1	50	47.3	67	53.3	50	47.4	67	59.6	50	47.6	68	05.8
2 30	+51	28.7	-	70 33.2	+51	28.6	-	70 39.0	+51	28.5	-	70 44.7	+51	28.5	-	70 50.5
35	52	52.2	76	46.7	52	51.8	76	51.5	52	51.4	76	56.4	52	51.0	77	01.2
40	53	55.0	82	20.8	53	54.3	82	25.0	53	53.7	82	29.2	53	53.1	82	33.3
45	54	42.3	87	29.1	54	41.5	87	32.7	54	40.7	87	36.3	54	39.9	87	40.0
50	55	17.2	92	18.4	55	16.2	92	21.6	55	15.3	92	24.7	55	14.4	92	27.9
55	55	41.6	96	52.8	55	40.6	96	55.5	55	39.6	96	58.2	55	38.5	97	00.9
3 00	+55	56.9	-101	14.6	+55	55.8	-101	16.9	+55	54.8	-101	19.2	+55	53.7	-101	21.5
05	56	04.2	105	25.4	56	03.0	105	27.3	56	01.9	105	29.2	56	00.7	105	31.1
10	56	04.1	109	26.1	56	02.9	109	27.6	56	01.7	109	29.2	56	00.5	109	30.7
15	55	57.3	113	17.5	55	56.1	113	18.7	55	54.9	113	19.9	55	53.7	113	21.1
20	55	44.4	117	00.1	55	43.2	117	01.0	55	41.9	117	01.9	55	40.7	117	02.7
25	55	25.8	120	34.3	55	24.6	120	34.9	55	23.4	120	35.5	55	22.1	120	36.1
3 30	+55	02.0	-124	00.7	+55	00.7	-124	01.0	+54	59.5	-124	01.3	+54	58.3	-124	01.6
35	54	33.2	127	19.6	54	32.0	127	19.7	54	30.8	127	19.7	54	29.6	127	19.7
40	53	59.8	130	31.5	53	58.6	130	31.3	53	57.4	130	31.1	53	56.3	130	30.9
45	53	22.0	133	37.0	53	20.9	133	36.5	53	19.7	133	36.0	53	18.6	133	35.6
50	52	40.1	136	36.5	52	39.0	136	35.8	52	37.9	136	35.1	52	36.8	136	34.4
55	51	54.2	139	30.6	51	53.2	139	29.7	51	52.1	139	28.8	51	51.1	139	27.9
4 00	+51	04.5	-142	20.0	+51	03.5	-142	18.9	+51	02.5	-142	17.9	+51	01.5	-142	16.8
05	50	11.0	145	05.5	50	10.1	145	04.2	50	09.1	145	03.0	50	08.2	145	01.7
10	49	13.8	147	47.8	49	12.9	147	46.4	49	12.0	147	44.9	49	11.1	147	43.4
15	48	12.9	150	27.8	48	12.0	150	26.2	48	11.2	150	24.6	48	10.4	150	22.9
20	47	08.1	153	06.5	47	07.4	153	04.7	47	06.6	153	02.9	47	05.9	153	01.1
25	45	59.4	155	45.1	45	58.8	155	43.1	45	58.1	155	41.1	45	57.4	155	39.1
4 30	+44	46.5	-158	24.8	+44	45.9	-158	22.6	+44	45.3	-158	20.5	+44	44.7	-158	18.3
35	43	29.0	161	07.4	43	28.5	161	05.0	43	28.0	161	02.7	43	27.5	161	00.3
40	42	06.4	163	55.0	42	06.0	163	52.4	42	05.6	163	49.8	42	05.2	163	47.2
45	40	37.8	166	50.2	40	37.5	166	47.4	40	37.3	166	44.5	40	37.0	166	41.7
50	39	02.0	169	57.1	39	01.9	169	54.0	39	01.7	169	50.9	39	01.6	169	47.7
55	37	17.0	173	21.7	37	17.1	173	18.2	37	17.1	173	14.6	37	17.2	173	11.1
5 00	+35	19.4	-177	14.2	+35	19.7	-177	10.1	+35	20.0	-177	06.0	+35	20.2	-177	01.9
02	34	27.4	-178	59.0	34	27.8	-178	54.6	34	28.2	-178	50.2	34	28.6	-178	45.8
04	33	31.6	+179	06.5	33	32.1	+179	11.3	33	32.7	+179	16.1	33	33.3	+179	20.9
06	32	30.7	176	58.8	32	31.5	177	04.2	32	32.3	177	09.5	32	33.0	177	14.8
08	31	22.8	174	32.1	31	23.9	174	38.2	31	24.9	174	44.3	31	26.0	174	50.4
5 10	+30	03.9	+171	34.6	+30	05.4	+171	42.1	+30	06.9	+171	49.5	+30	08.5	+171	56.9
11	29	17.6	169	46.6	29	19.5	169	55.2	29	21.5	170	03.8	29	23.3	170	12.2
12	28	23.3	167	35.5	28	25.9	167	46.1	28	28.5	167	56.5	28	31.0	168	06.7
13	+27	12.9	+164	37.3	+27	17.1	+164	52.4	+27	21.1	+165	07.1	27	25.0	165	21.3
14	..	..	..	..	..	..	..	..	..	..	..	..	+25	20.6	+159	43.5

DURATION OF TOTAL PHASE AND WIDTH OF PATH ON CENTRAL LINE

Universal Time	10,000 Feet			20,000 Feet			30,000 Feet			40,000 Feet		
	Duration		Width of Path mi	Duration		Width of Path mi	Duration		Width of Path mi	Duration		Width of Path mi
	h	m		m	s		m	s		m	s	
2 18												
19	0	44.1	40	0	44.6	41	0	45.1	41	0	45.6	41
	0	49.9	44	0	50.1	44	0	50.4	44	0	50.7	44
2 20	0	53.6	46	0	53.8	46	0	54.0	47	0	54.2	47
22	0	59.2	49	0	59.4	49	0	59.5	49	0	59.7	49
24	1	03.8	52	1	03.9	52	1	04.1	52	1	04.2	52
26	1	07.7	53	1	07.9	53	1	08.0	53	1	08.1	53
28	1	11.3	55	1	11.4	55	1	11.5	55	1	11.7	55
2 30	1	14.6	56	1	14.7	56	1	14.8	56	1	14.9	56
35	1	21.8	59	1	22.0	59	1	22.1	59	1	22.2	59
40	1	28.2	60	1	28.3	60	1	28.4	60	1	28.5	60
45	1	33.7	62	1	33.8	62	1	33.9	62	1	34.0	62
50	1	38.7	63	1	38.8	63	1	38.9	64	1	39.0	64
55	1	43.1	64	1	43.2	64	1	43.3	64	1	43.4	64
3 00	1	47.0	65	1	47.2	65	1	47.2	65	1	47.3	65
05	1	50.5	66	1	50.6	66	1	50.7	66	1	50.8	66
10	1	53.5	67	1	53.6	67	1	53.7	67	1	53.8	67
15	1	56.1	67	1	56.2	67	1	56.3	67	1	56.4	68
20	1	58.2	67	1	58.3	67	1	58.4	67	1	58.5	68
25	1	59.9	68	2	00.0	68	2	00.1	68	2	00.2	68
3 30	2	01.2	68	2	01.3	68	2	01.4	68	2	01.5	68
35	2	02.0	69	2	02.1	69	2	02.2	69	2	02.3	68
40	2	02.5	69	2	02.6	69	2	02.7	69	2	02.8	69
45	2	02.5	69	2	02.6	69	2	02.7	69	2	02.8	69
50	2	02.1	69	2	02.2	69	2	02.3	69	2	02.4	69
55	2	01.3	69	2	01.4	69	2	01.5	69	2	01.5	69
4 00	2	00.1	69	2	00.2	69	2	00.2	69	2	00.3	69
05	1	58.4	69	1	58.5	69	1	58.6	69	1	58.7	69
10	1	56.4	69	1	56.5	69	1	56.6	69	1	56.7	69
15	1	54.0	68	1	54.1	68	1	54.2	68	1	54.3	68
20	1	51.2	68	1	51.3	68	1	51.4	68	1	51.5	68
25	1	48.0	67	1	48.1	67	1	48.2	67	1	48.2	68
4 30	1	44.4	67	1	44.4	67	1	44.5	67	1	44.6	67
35	1	40.3	66	1	40.4	66	1	40.5	66	1	40.6	66
40	1	35.8	65	1	35.9	65	1	36.0	64	1	36.1	64
45	1	30.9	63	1	31.0	63	1	31.1	64	1	31.2	64
50	1	25.4	62	1	25.5	62	1	25.6	62	1	25.7	62
55	1	19.3	59	1	19.4	60	1	19.5	60	1	19.6	60
5 00	1	12.4	56	1	12.5	56	1	12.6	56	1	12.7	56
02	1	09.3	55	1	09.4	55	1	09.5	55	1	09.6	55
04	1	06.0	53	1	06.1	53	1	06.2	53	1	06.4	53
06	1	02.4	52	1	02.5	52	1	02.7	52	1	02.8	52
08	0	58.4	49	0	58.6	49	0	58.7	49	0	58.9	49
5 10	0	53.8	47	0	53.9	47	0	54.1	47	0	54.3	47
11	0	51.1	45	0	51.2	45	0	51.4	45	0	51.6	45
12	0	47.9	43	0	48.1	43	0	48.3	43	0	48.6	43
13	0	43.8	40	0	44.1	40	0	44.4	40	0	44.7	41
14	.	..	...	.	..	...	.	..	...	0	37.5	36

CENTRAL LINE OF TOTAL PHASE

Universal Time	80 Km				100 Km				200 Km				300 Km			
	Latitude		Longitude		Latitude		Longitude		Latitude		Longitude		Latitude		Longitude	
	h	m	°	'	°	'	°	'	°	'	°	'	°	'	°	'
2 12	..	..	..	..	..	..	..	..	..	..	..	..	+42	05.2	-	47 18.3
14	..	..	..	..	..	..	..	..	+42	31.9	-	46 12.9	44	39.6	55	01.7
16	..	..	..	..	+42	56.7	-	44 57.4	45	12.3	54	14.0	46	06.8	59	37.3
18	+45	28.8	-	52 00.1	45	45.4	53	22.6	46	41.2	58	55.6	47	12.7	63	16.3
2 20	+47	07.6	-	57 10.3	+47	16.4	-	58 11.2	+47	48.3	-	62 39.2	+48	06.6	-	66 24.9
22	48	19.6	61	08.8	48	24.7	61	59.8	48	43.0	65	51.8	48	52.5	69	14.1
24	49	17.7	64	31.8	49	20.5	65	16.8	49	29.6	68	44.6	49	32.5	71	49.4
26	50	06.6	67	32.9	50	07.7	68	13.6	50	10.1	71	23.4	50	07.7	74	14.3
28	50	48.9	70	18.8	50	48.8	70	56.1	50	45.7	73	51.7	50	39.1	76	31.0
2 30	+51	26.0	-	72 53.4	+51	24.9	-	73 28.0	+51	17.4	-	76 11.7	+51	07.2	-	78 41.1
35	52	41.6	78	45.3	52	38.7	79	14.8	52	22.8	81	35.0	52	05.6	83	44.2
40	53	38.9	84	03.3	53	34.6	84	28.9	53	12.8	86	30.8	52	50.4	88	23.6
45	54	22.1	88	58.2	54	16.9	89	20.5	53	50.6	91	06.8	53	24.2	92	45.4
50	54	54.0	93	35.8	54	48.0	93	55.1	54	18.2	95	27.6	53	48.8	96	53.4
55	55	16.1	97	59.4	55	09.5	98	16.1	54	37.0	99	35.7	54	05.2	100	49.7
3 00	+55	29.6	-102	11.2	+55	22.6	-102	25.4	+54	48.1	-103	33.1	+54	14.5	-104	36.1
05	55	35.5	106	12.5	55	28.2	106	24.4	54	52.2	107	20.9	54	17.3	108	13.4
10	55	34.5	110	04.4	55	26.9	110	14.0	54	49.9	110	59.8	54	14.1	111	42.6
15	55	27.1	113	47.3	55	19.4	113	54.8	54	41.8	114	30.7	54	05.4	115	04.0
20	55	14.0	117	22.0	55	06.2	117	27.5	54	28.2	117	53.8	53	51.7	118	18.3
25	54	55.4	120	48.8	54	47.6	120	52.4	54	09.7	121	09.7	53	33.2	121	25.9
3 30	+54	31.8	-124	08.1	+54	24.1	-124	09.9	+53	46.4	-124	18.8	+53	10.2	-124	27.0
35	54	03.4	127	20.3	53	55.8	127	20.5	53	18.8	127	21.4	52	43.1	127	22.2
40	53	30.7	130	26.0	53	23.2	130	24.7	52	47.0	130	18.0	52	12.0	130	11.8
45	52	53.7	133	25.6	52	46.5	133	22.8	52	11.2	133	09.0	51	37.2	132	56.1
50	52	12.8	136	19.6	52	05.8	136	15.4	51	31.7	135	55.0	50	58.7	135	35.8
55	51	28.0	139	08.6	51	21.3	139	03.0	50	48.5	138	36.3	50	16.8	138	11.2
4 00	+50	39.5	-141	53.1	+50	33.1	-141	46.3	+50	01.8	-141	13.6	+49	31.5	-140	42.8
05	49	47.4	144	33.9	49	41.3	144	26.0	49	11.6	143	47.5	48	42.9	143	11.3
10	48	51.6	147	11.7	48	46.0	147	02.6	48	18.1	146	18.7	47	51.0	145	37.1
15	47	52.3	149	47.4	47	47.1	149	37.2	47	21.1	148	47.8	46	55.9	148	01.1
20	46	49.3	152	21.7	46	44.5	152	10.4	46	20.6	151	15.7	45	57.4	150	23.9
25	45	42.5	154	55.9	45	38.1	154	43.5	45	16.6	153	43.4	44	55.4	152	46.5
4 30	+44	31.7	-157	31.1	+44	27.8	-157	17.5	+44	08.7	-156	11.9	+43	49.9	-155	09.7
35	43	16.4	160	08.9	43	13.1	159	54.1	42	56.8	158	42.6	42	40.5	157	34.9
40	41	56.3	162	51.1	41	53.7	162	35.0	41	40.3	161	17.1	41	26.8	160	03.5
45	40	30.6	165	40.3	40	28.7	165	22.6	40	18.8	163	57.5	40	08.4	162	37.2
50	38	58.3	168	39.8	38	57.2	168	20.4	38	51.3	166	46.8	38	44.6	165	18.7
55	37	17.6	171	54.9	37	17.5	171	33.2	37	16.5	169	48.9	37	14.1	168	11.4
5 00	+35	25.6	-175	34.0	+35	27.0	-175	09.1	+35	32.1	-173	10.4	+35	35.2	-171	20.4
02	34	36.6	177	11.5	34	38.7	176	44.9	34	47.0	174	38.6	34	52.7	172	42.4
04	33	44.4	178	56.9	33	47.3	178	28.1	33	59.4	176	12.8	34	08.2	174	09.2
06	32	48.3	+179	07.5	32	52.2	+179	38.9	33	08.7	177	54.3	33	21.1	175	41.8
08	31	46.7	176	57.8	31	52.1	177	32.9	32	14.4	-179	45.4	32	31.2	177	21.7
5 10	+30	37.7	+174	27.5	+30	45.0	+175	08.0	+31	15.1	+178	10.6	+31	37.5	-179	11.1
12	29	16.3	171	23.0	29	26.9	172	12.7	30	09.0	175	48.1	30	39.1	+178	46.8
14	-27	29.0	+167	03.8	-27	47.6	+168	16.4	28	52.3	172	55.9	29	33.9	176	26.4
16	..	..	..	..	..	..	..	..	-27	14.9	+169	04.7	28	18.3	173	36.9
18	..	..	..	..	..	..	..	..	..	..	..	..	-26	42.6	+169	49.9

DURATION OF TOTAL PHASE AND WIDTH OF PATH ON CENTRAL LINE

Universal Time	80 Km			100 Km			200 Km			300 Km			Width of Path mi
	Duration		Width of Path mi	Duration		Width of Path mi	Duration		Width of Path mi	Duration			
	h	m		m	s		m	s		m	s	m		s
2 12	.	..	.	..	.	..	.	..	.	..	0 45.4	41	
14	.	..	.	..	.	..	0 44.9	41	0 54.6	46			
16	.	..	.	..	0 44.3	40	0 54.2	46	1 00.4	49			
18	0	52.3	46	0 53.8	46	1 00.0	49	1 05.2	51				
2 20	0	58.4	49	0 59.5	49	1 04.7	52	1 09.3	53				
22	1 03.2	51	1 04.2	52	1 08.8	53	1 12.4	55	1 13.0	55			
24	1 07.3	53	1 08.2	53	1 12.4	55	1 15.8	56	1 16.5	56			
26	1 11.0	54	1 11.8	55	1 15.8	56	1 19.0	56	1 19.7	56			
28	1 14.4	55	1 15.1	56	1 19.0	56	1 22.7	58	1 22.7	58			
2 30	1 17.5	57	1 18.3	57	1 22.0	58	1 25.6	59	1 25.6	59			
35	1 24.6	59	1 25.3	59	1 28.7	60	1 32.2	61	1 32.2	61			
40	1 30.7	61	1 31.4	61	1 34.7	61	1 38.1	62	1 38.1	62			
45	1 36.2	63	1 36.9	63	1 40.1	63	1 43.4	64	1 43.4	64			
50	1 41.1	63	1 41.8	64	1 45.0	65	1 48.2	65	1 48.2	65			
55	1 45.5	65	1 46.2	64	1 49.3	65	1 52.5	66	1 52.5	66			
3 00	1 49.4	66	1 50.1	65	1 53.2	66	1 56.4	66	1 56.4	66			
05	1 52.9	67	1 53.5	66	1 56.6	67	1 59.8	67	1 59.8	67			
10	1 55.9	67	1 56.5	67	1 59.6	67	2 02.8	68	2 02.8	68			
15	1 58.4	67	1 59.0	68	2 02.1	68	2 05.3	68	2 05.3	68			
20	2 00.6	68	2 01.2	68	2 04.3	69	2 07.4	69	2 07.4	69			
25	2 02.2	68	2 02.9	68	2 05.9	69	2 09.1	69	2 09.1	69			
3 30	2 03.5	69	2 04.1	68	2 07.2	69	2 10.3	70	2 10.3	70			
35	2 04.4	69	2 05.0	69	2 08.0	69	2 11.1	70	2 11.1	70			
40	2 04.8	69	2 05.4	69	2 08.4	69	2 11.6	70	2 11.6	70			
45	2 04.8	69	2 05.4	69	2 08.4	69	2 11.5	70	2 11.5	70			
50	2 04.4	69	2 05.0	69	2 08.0	69	2 11.1	70	2 11.1	70			
55	2 03.6	69	2 04.2	69	2 07.2	69	2 10.3	70	2 10.3	70			
4 00	2 02.4	69	2 02.9	69	2 06.0	69	2 09.0	70	2 09.0	70			
05	2 00.7	69	2 01.3	69	2 04.3	69	2 07.4	70	2 07.4	70			
10	1 58.7	69	1 59.3	69	2 02.3	69	2 05.3	70	2 05.3	70			
15	1 56.3	69	1 56.9	68	1 59.9	69	2 02.9	70	2 02.9	70			
20	1 53.4	68	1 54.0	68	1 57.0	69	2 00.1	69	2 00.1	69			
25	1 50.2	67	1 50.8	68	1 53.8	68	1 56.9	69	1 56.9	69			
4 30	1 46.6	67	1 47.2	67	1 50.2	68	1 53.2	68	1 53.2	68			
35	1 42.6	66	1 43.2	66	1 46.2	67	1 49.2	67	1 49.2	67			
40	1 38.1	65	1 38.8	65	1 41.8	65	1 44.8	66	1 44.8	66			
45	1 33.3	63	1 33.9	64	1 37.0	65	1 40.0	65	1 40.0	65			
50	1 27.8	62	1 28.5	62	1 31.6	63	1 34.8	64	1 34.8	64			
55	1 21.8	60	1 22.5	60	1 25.7	61	1 29.0	62	1 29.0	62			
5 00	1 15.1	57	1 15.8	57	1 19.2	59	1 22.6	60	1 22.6	60			
02	1 12.1	56	1 12.9	56	1 16.4	57	1 19.9	59	1 19.9	59			
04	1 09.0	55	1 09.7	55	1 13.4	56	1 17.0	57	1 17.0	57			
06	1 05.6	53	1 06.4	53	1 10.2	55	1 14.0	56	1 14.0	56			
08	1 01.9	51	1 02.7	52	1 06.9	53	1 10.7	55	1 10.7	55			
5 10	0 57.7	49	0 58.7	49	1 03.1	52	1 07.3	53	1 07.3	53			
12	0 52.9	46	0 54.0	47	0 59.0	49	1 03.5	51	1 03.5	51			
14	0 46.5	42	0 48.0	43	0 54.3	47	0 59.4	49	0 59.4	49			
16	.	..	.	..	0 48.4	43	0 54.6	46	0 54.6	46			
18	.	..	.	..	.	..	0 48.6	42	0 48.6	42			

LOCAL CIRCUMSTANCES FOR POINTS ON CENTRAL LINE

Universal Time	Central Line		First Contact			Second Contact		
	Latitude	Longitude	Universal Time	P	V	Universal Time	P	V
	h m ° ' "	h m ° ' "	h m s ° ' "	° ' "	° ' "	h m s ° ' "	° ' "	° ' "
2 18	+43 18.2	- 43 27.6	.. .. .	...	...	2 17 37.0	93	138
19	45 12.7	49 05.6	.. .. .	...	...	2 18 33.9	93	138
2 20	+46 18.9	- 52 27.1	1 24 14.2	273	314	2 19 32.0	93	138
22	47 52.4	57 23.7	1 24 37.0	273	315	2 21 29.1	94	138
24	49 02.1	61 18.0	1 25 17.8	274	315	2 23 26.8	94	137
26	49 58.9	64 39.7	1 26 08.3	274	315	2 25 24.8	94	137
28	50 47.0	67 40.8	1 27 05.2	274	315	2 27 23.0	94	136
2 30	+51 28.7	- 70 27.4	1 28 06.6	274	314	2 29 21.3	95	136
35	52 52.6	76 41.8	1 30 54.3	275	314	2 34 17.6	95	134
40	53 55.6	82 16.6	1 33 56.3	275	314	2 39 14.4	96	133
45	54 43.1	87 25.4	1 37 08.6	276	313	2 44 11.6	96	131
50	55 18.1	92 15.3	1 40 29.5	276	312	2 49 09.1	97	130
55	55 42.6	96 50.1	1 43 57.6	277	312	2 54 06.8	98	128
3 00	+55 58.0	-101 12.3	1 47 32.4	277	311	2 59 04.8	98	125
05	56 05.3	105 23.4	1 51 13.6	278	310	3 04 03.1	99	123
10	56 05.3	109 24.5	1 55 01.0	278	309	3 09 01.5	100	120
15	55 58.5	113 16.3	1 58 54.5	279	307	3 14 00.2	100	117
20	55 45.6	116 59.2	2 02 54.3	280	306	3 18 59.2	101	114
25	55 27.0	120 33.8	2 07 00.4	280	304	3 23 58.3	101	111
3 30	+55 03.2	-124 00.4	2 11 13.1	281	302	3 28 57.6	102	107
35	54 34.4	127 19.6	2 15 32.6	281	300	3 33 57.2	103	103
40	54 00.9	130 31.8	2 19 59.0	282	297	3 38 56.9	103	100
45	53 23.1	133 37.4	2 24 32.8	283	295	3 43 56.9	104	96
50	52 41.2	136 37.1	2 29 14.0	283	291	3 48 57.2	104	91
55	51 55.3	139 31.5	2 34 03.1	284	288	3 53 57.6	105	87
4 00	+51 05.5	-142 21.1	2 39 00.4	284	284	3 58 58.2	105	84
05	50 12.0	145 06.8	2 44 06.1	285	279	4 03 59.0	106	80
10	49 14.7	147 49.3	2 49 20.6	285	275	4 09 00.1	106	76
15	48 13.7	150 29.5	2 54 44.0	286	270	4 14 01.3	107	72
20	47 08.9	153 08.3	3 00 16.9	286	265	4 19 02.7	107	69
25	46 00.1	155 47.1	3 05 59.4	287	259	4 24 04.3	107	66
4 30	+44 47.1	-158 27.0	3 11 52.0	287	254	4 29 06.2	107	63
35	43 29.5	161 09.8	3 17 55.0	288	249	4 34 08.2	108	60
40	42 06.8	163 57.5	3 24 09.3	288	245	4 39 10.5	108	58
45	40 38.1	166 53.1	3 30 35.6	288	241	4 44 13.0	108	55
50	39 02.2	170 00.3	3 37 15.1	288	237	4 49 15.8	108	53
55	37 17.0	173 25.2	3 44 09.8	288	233	4 54 18.8	108	51
5 00	+35 19.1	-177 18.3	3 51 23.9	288	229	4 59 22.4	108	49
02	34 27.0	179 03.4	3 54 24.4	288	228	5 01 23.9	108	48
04	33 31.0	179 01.7	3 57 30.1	288	227	5 03 25.6	108	47
06	32 29.9	176 53.4	4 00 42.3	288	225	5 05 27.4	107	46
08	31 21.7	174 25.9	4 04 03.5	288	224	5 07 29.5	107	45
5 10	+30 02.3	+171 27.1	4 07 38.5	288	223	5 09 31.9	107	44
11	29 15.6	169 37.9	4 09 34.4	288	222	5 10 33.2	107	44
12	28 20.6	167 24.8	4 11 40.3	287	221	5 11 34.9	107	43
13	27 08.5	164 21.5	4 14 06.7	287	220	5 12 37.0	106	43

LOCAL CIRCUMSTANCES FOR POINTS ON CENTRAL LINE

Maximum Eclipse			Third Contact			Fourth Contact			Duration		Width of Path
Universal Time	Magnitude	Sun's Alt. Az.	Universal Time	P	V	Universal Time	P	V	m	s	
h m s		o o	h m s	o	o	h m s	o	o			mi
2 18 00.0	1.014	3 68	2 18 23.0	273	318	3 15 00.5	93	141	0 46.0		40
2 19 00.0	1.015	8 72	2 19 26.1	273	318	3 18 04.3	93	141	0 52.2		44
2 20 00.0	1.016	10 74	2 20 28.0	273	318	3 20 20.6	93	140	0 56.0		46
2 22 00.0	1.017	14 78	2 22 30.9	274	318	3 24 15.2	94	139	1 01.8		49
2 24 00.0	1.018	17 82	2 24 33.2	274	317	3 27 46.7	94	138	1 06.4		52
2 26 00.0	1.019	20 85	2 26 35.2	274	317	3 31 05.3	94	137	1 10.4		53
2 28 00.0	1.020	22 88	2 28 37.0	274	316	3 34 15.4	95	136	1 14.0		55
2 30 00.0	1.020	24 91	2 30 38.7	275	316	3 37 18.9	95	135	1 17.4		55
2 35 00.0	1.021	29 98	2 35 42.4	275	314	3 44 36.9	96	132	1 24.8		59
2 40 00.0	1.022	33 104	2 40 45.6	276	313	3 51 32.4	97	129	1 31.2		60
2 45 00.0	1.023	36 111	2 45 48.4	276	311	3 58 10.3	97	125	1 36.8		62
2 50 00.0	1.024	39 117	2 50 50.9	277	309	4 04 33.5	98	121	1 41.8		63
2 55 00.0	1.024	42 124	2 55 53.2	278	307	4 10 43.6	99	118	1 46.4		64
3 00 00.0	1.025	44 130	3 00 55.2	278	305	4 16 41.7	99	114	1 50.4		65
3 05 00.0	1.025	46 137	3 05 56.9	279	303	4 22 28.7	100	110	1 53.8		66
3 10 00.0	1.026	48 144	3 10 58.5	280	300	4 28 05.5	101	105	1 57.0		67
3 15 00.0	1.026	50 151	3 15 59.8	280	297	4 33 32.6	101	101	1 59.6		67
3 20 00.0	1.026	51 158	3 21 00.8	281	294	4 38 50.5	102	97	2 01.6		67
3 25 00.0	1.026	52 165	3 26 01.7	282	290	4 43 59.9	103	93	2 03.4		68
3 30 00.0	1.027	53 172	3 31 02.4	282	287	4 49 01.0	103	90	2 04.8		68
3 35 00.0	1.027	54 179	3 36 02.8	283	283	4 53 54.6	104	86	2 05.6		69
3 40 00.0	1.027	54 186	3 41 03.1	283	279	4 58 40.9	104	83	2 06.2		69
3 45 00.0	1.027	54 194	3 46 03.1	284	275	5 03 20.4	105	80	2 06.2		69
3 50 00.0	1.027	54 201	3 51 02.8	284	271	5 07 53.3	105	77	2 05.6		69
3 55 00.0	1.026	54 208	3 56 02.4	285	267	5 12 20.0	106	74	2 04.8		69
4 00 00.0	1.026	53 214	4 01 01.8	285	263	5 16 40.9	106	71	2 03.6		69
4 05 00.0	1.026	52 221	4 06 01.0	286	259	5 20 56.2	106	69	2 02.0		69
4 10 00.0	1.026	51 227	4 10 59.9	286	256	5 25 06.1	107	67	1 59.8		69
4 15 00.0	1.026	50 233	4 15 58.7	287	252	5 29 10.7	107	65	1 57.4		68
4 20 00.0	1.025	48 239	4 20 57.3	287	249	5 33 10.1	107	63	1 54.6		68
4 25 00.0	1.025	47 244	4 25 55.7	287	246	5 37 04.6	107	61	1 51.4		67
4 30 00.0	1.024	45 249	4 30 53.8	287	243	5 40 53.8	107	59	1 47.6		67
4 35 00.0	1.024	42 254	4 35 51.8	288	240	5 44 37.9	107	57	1 43.6		66
4 40 00.0	1.023	40 258	4 40 49.5	288	238	5 48 16.2	108	56	1 39.0		65
4 45 00.0	1.023	37 263	4 45 47.0	288	235	5 51 48.4	108	54	1 34.0		63
4 50 00.0	1.022	34 267	4 50 44.2	288	233	5 55 13.4	107	53	1 28.4		62
4 55 00.0	1.021	30 271	4 55 41.2	288	231	5 58 29.7	107	52	1 22.4		59
5 00 00.0	1.020	26 275	5 00 37.6	288	229	6 01 34.3	107	50	1 15.2		56
5 02 00.0	1.019	24 276	5 02 36.1	288	228	6 02 43.6	107	50	1 12.2		55
5 04 00.0	1.018	22 278	5 04 34.4	288	227	6 03 49.4	107	49	1 08.8		53
5 06 00.0	1.018	20 280	5 06 32.6	287	226	6 04 50.7	107	48	1 05.2		52
5 08 00.0	1.017	17 281	5 08 30.5	287	225	6 05 45.6	106	48	1 01.0		49
5 10 00.0	1.016	14 283	5 10 28.1	287	224	6 06 30.3	106	47	0 56.2		47
5 11 00.0	1.015	12 285	5 11 26.8	287	224	6 06 46.4	106	47	0 53.6		44
5 12 00.0	1.015	9 286	.. .. .	...	...	6 06 55.0	106	46	0 50.2		43
5 13 00.0	1.014	6 287	.. .. .	...	...	6 06 47.9	106	46	0 46.0		40

LOCAL CIRCUMSTANCES

Geographic Locations	Latitude		Longitude		First Contact			Second Contact		
					Universal Time			Universal Time		
	°	'	°	'	h	m	s	P	°	V
Outside U.S.S.R.										
Kabul, Afghanistan	+34	39.0	- 69	14.0	1	12	33.8	297	352	
Helsinki, Finland	+60	10.0	- 24	53.0	..	..	..	...	...	
Delhi, India	+28	54.0	- 77	13.0	1	15	34.9	312	15	
Tehran, Iran	+35	45.0	- 51	30.0	..	..	..	...	...	
Baghdad, Iraq	+33	14.0	- 44	22.0	..	..	..	...	...	
Jerusalem, Israel	+31	46.0	- 35	14.0	..	..	..	...	...	
Kyoto, Japan	+35	00.0	-135	46.0	2	46	46.1	314	326	
Nagasaki, Japan	+32	48.0	-129	53.0	2	39	25.5	321	355	
Tokyo, Japan	+35	41.0	-139	44.0	2	53	30.1	311	307	
Seoul, Korea	+37	35.0	-127	03.0	2	23	15.8	311	348	
Kuwait	+29	04.0	- 47	59.0	..	..	..	...	...	
Ulaan Baatar, Mongolia	+47	56.0	-107	00.0	1	45	24.4	291	332	
Kathmandu, Nepal	+27	49.0	- 85	21.0	1	23	26.0	320	26	
Oslo, Norway	+59	56.0	- 10	41.0	..	..	..	...	...	
Karachi, Pakistan	+24	59.0	- 68	56.0	1	13	51.1	314	19	
Lahore, Pakistan	+32	00.0	- 74	18.0	1	13	22.9	304	4	
Kueiyang, P.R.C.	+26	45.0	-107	00.0	2	06	41.6	338	48	
Kunming, P.R.C.	+25	10.0	-102	50.0	2	03	43.4	342	55	
Nanking, P.R.C.	+32	04.0	-118	46.0	2	16	24.8	324	21	
Peking, P.R.C.	+39	55.0	-116	23.0	1	59	26.3	306	354	
Shenyang, P.R.C.	+41	45.0	-123	22.0	2	11	02.8	303	341	
Warsaw, Poland	+52	15.0	- 21	05.0	..	..	..	...	...	
Bucharest, Rumania	+44	23.0	- 26	10.0	..	..	..	...	...	
Stockholm, Sweden	+59	23.0	- 18	00.0	..	..	..	...	...	
Ankara, Turkey	+39	55.0	- 32	50.0	..	..	..	...	...	
Ardesen, Turkey	+41	12.3	- 41	02.9	..	..	..	...	...	
Cayeli, Turkey	+41	05.2	- 40	44.0	..	..	..	...	...	
Istanbul, Turkey	+41	02.0	- 29	00.0	..	..	..	...	...	
Anchorage, Alaska, U.S.A.	+61	12.0	+149	48.0	3	33	40.0	246	216	
Honolulu, Hawaii, U.S.A.	+21	18.0	+157	50.0	4	21	59.3	291	220	
U.S.S.R.										
Abakan	+53	43.0	- 91	26.0	1	37	47.8	278	316	
Aban	+56	40.5	- 96	03.0	1	44	47.6	275	309	
Abastumani	+41	45.2	- 42	50.0	..	..	..	...	...	
Achinsk	+56	15.0	- 90	28.0	1	40	54.8	275	310	
Akshiganak	+49	17.3	- 62	43.0	1	25	25.4	274	315	2 24 04.3 116 159
Aksu	+52	28.0	- 71	57.0	1	29	37.9	274	313	
Aleksandrovsk-Sakhalinskiy	+50	54.0	-142	08.0	2	38	45.7	285	284	3 59 00.8 133 111
Alekseyevka	+52	00.0	- 70	56.0	1	28	52.9	274	313	2 30 43.0 25 66
Aleysk	+52	30.0	- 82	46.0	1	32	02.6	277	317	
Alhali-Kindgi	+42	47.5	- 41	16.5	..	..	..	...	...	2 17 52.6 42 87
Alma-Ata	+43	19.0	- 77	08.0	1	19	34.4	287	337	
Alzamay	+55	33.0	- 98	40.0	1	45	02.9	277	312	
Amangel'dy	+50	11.0	- 65	12.0	1	26	22.1	274	314	2 56 04.2 135 164
Anar	+50	40.0	- 72	24.0	1	27	07.6	276	317	2 25 50.0 87 129
Anzhero-Sudzhensk	+56	05.0	- 86	03.0	1	38	37.1	274	309	
Ardon	+43	10.0	- 44	18.0	..	..	..	...	...	
Arkalyk	+50	15.0	- 66	54.0	1	26	22.4	274	315	2 26 36.8 146 188
Armavir	+45	00.0	- 41	07.0	..	..	..	...	...	
Artemovsk	+54	21.3	- 93	26.0	1	39	52.1	278	315	
Artyshita	+54	12.0	- 86	17.0	1	35	52.6	276	314	2 42 53.5 148 183

LOCAL CIRCUMSTANCES

Obscuration	Maximum Eclipse			Magnitude	Sun's		Third Contact			Fourth Contact			Duration		Width of Path				
	Universal Time				Alt.	Az.	Universal Time			P	V	Universal Time				P	V		
	%	h	m				s	o	o			h	m	s	o			o	h	m	s	o	o	m	s	mi
49.9	2	07	41.5	0.592	18	80						3	08	47.3	69	129			
49.3	2	44	13.1	0.587	4	59						3	34	04.3	120	149			
25.2	2	05	21.4	0.365	23	81						3	00	29.5	53	120			
71.0	2	08	01.9	0.767	4	70						3	05	14.4	79	135			
....	..	..	..	..	..	...						3	02	01.4	78	136			
....	..	..	..	..	..	...						3	02	37.6	81	137			
43.6	4	09	35.3	0.537	68	226						5	26	18.5	81	25			
30.5	3	58	03.4	0.417	74	208						5	12	48.7	72	18			
50.6	4	17	03.8	0.597	64	235						5	33	24.3	85	28			
43.5	3	45	36.2	0.536	71	185						5	05	51.7	79	38			
....	..	..	..	..	..	...						2	55	25.0	70	132			
73.5	3	01	51.9	0.785	52	131						4	23	22.4	88	99			
16.2	2	11	10.9	0.269	31	85						3	03	57.8	47	115			
....	..	..	..	..	..	...						3	35	48.9	124	151			
21.3	1	58	05.5	0.325	14	76						2	46	27.3	49	120			
36.9	2	06	53.2	0.478	22	81						3	06	20.3	61	125			
5.4	2	51	30.7	0.127	60	99						3	39	20.5	39	101			
3.0	2	39	35.4	0.085	53	93						3	17	42.4	31	102			
20.6	3	26	38.5	0.318	73	141						4	38	23.0	62	39			
45.7	3	18	12.1	0.555	65	143						4	39	58.7	77	67			
55.4	3	33	51.4	0.638	66	169						4	56	40.7	83	56			
....	..	..	..	..	..	...						3	26	46.9	113	148			
....	..	..	..	..	..	...						3	18	21.2	102	145			
46.3	2	45	57.4	0.562	1	54						3	33	57.9	121	150			
....	..	..	..	..	..	...						3	12	14.8	93	142			
97.7	2	16	30.2	0.978	0	66						3	12	28.7	91	141			
....	..	..	..	..	..	...						3	12	21.3	91	141			
....	..	..	..	..	..	...						3	14	22.4	96	143			
28.7	4	20	16.0	0.401	14	282						5	05	03.9	140	111			
....	..	..	..	..	..	...						..	..	..	...	...			
97.2	2	47	19.7	0.973	39	114						4	02	19.0	96	122			
98.7	2	55	13.5	0.985	41	124						4	10	10.1	100	119			
97.5	2	16	29.6	0.977	2	67						3	13	05.2	91	141			
98.3	2	49	31.6	0.982	38	116						4	03	02.0	100	123			
100.0	2	24	35.9	1.019	18	83	2	25	07.4	252	295	3	28	55.8	94	137	1	03.1	52
99.7	2	32	03.2	0.995	26	93						3	39	50.2	96	134			
100.0	3	59	55.7	1.026	54	214	4	00	50.6	258	235	5	16	46.3	106	71	1	49.8	69
100.0	2	30	56.9	1.020	25	92	2	31	10.7	344	24	3	38	23.5	96	134	0	27.7	56
97.2	2	38	23.4	0.973	33	103						3	50	30.8	94	128			
100.0	2	18	06.4	1.014	1	66	2	18	20.1	324	9	3	14	22.6	93	142	0	27.5	41
71.1	2	22	05.0	0.766	28	90						3	31	22.2	81	129			
100.0	2	56	47.4	1.025	43	126	2	57	30.6	241	270	4	13	06.4	99	116	1	26.4	64
100.0	2	26	25.3	1.019	20	86	2	27	00.5	282	324	3	31	43.0	95	137	1	10.5	53
98.0	2	29	39.1	0.980	26	92						3	37	50.3	93	133			
97.1	2	45	42.0	0.972	35	110						3	57	48.1	100	127			
99.9	2	17	37.0	0.997	3	68						3	14	52.4	92	141			
100.0	2	26	59.5	1.019	22	87	2	27	22.1	223	265	3	32	57.9	94	136	0	45.3	54
94.5	2	20	35.6	0.953	2	66						3	17	01.2	96	143			
98.5	2	50	02.3	0.984	40	118						4	05	25.5	97	120			
100.0	2	43	23.5	1.023	35	109	2	43	53.4	225	261	3	56	20.8	97	126	0	59.9	61

LOCAL CIRCUMSTANCES

Geographic Locations	Latitude		Longitude		First Contact			Second Contact		
	Universal Time		P		V	Universal Time			P	V
	h	m	s	°		°	h	m	s	°
U.S.S.R. (Continued)										
Astrakhan	+46	20.0	- 48	00.0	..	..	..	..	...	...
Atbasar	+51	49.0	- 68	21.0	1	28	32.1	273	313	
Baksan	+43	41.0	- 43	32.0	..	..	..	..	...	...
Balakhta	+55	24.0	- 91	37.0	1	40	16.3	276	312	2 48 44.3 76 109
Balkashino	+52	30.0	- 68	45.0	1	29	31.7	272	311	
Barnaul	+53	22.0	- 83	45.0	1	33	38.4	276	315	
Batumi	+41	38.8	- 41	39.5	..	..	..	..	...	...
Bayevo	+53	17.5	- 80	46.0	1	32	31.4	276	315	2 37 39.4 151 189
Belovo	+54	25.0	- 86	18.0	1	36	12.1	276	314	2 42 55.9 114 150
Berchagur	+48	25.0	- 58	43.8	1	24	59.2	273	314	2 22 20.3 73 117
Berds	+54	46.0	- 83	05.0	1	35	28.4	274	312	
Bestobe	+52	30.0	- 73	05.0	1	29	47.5	274	313	2 32 20.9 28 68
Biryusinsk	+55	57.5	- 97	50.0	1	44	59.9	277	311	2 55 28.6 76 105
Biysk	+52	32.0	- 85	10.0	1	33	01.6	278	318	
Blagoveshchenka	+52	50.0	- 79	52.0	1	31	35.9	276	315	
Bol'shaya Urya	+56	02.0	- 95	29.0	1	43	30.7	276	311	2 53 37.3 31 61
Bol'sheohinskoye	+55	45.0	-101	44.0	1	47	41.2	278	311	2 59 36.8 129 156
Borodino	+55	55.5	- 94	54.0	1	42	59.0	276	311	2 52 44.3 45 76
Bratsk	+56	18.0	-101	45.0	1	48	24.4	277	310	3 00 12.8 57 84
Burla	+53	20.0	- 78	20.0	1	31	56.0	275	314	2 35 54.5 79 117
Chekanovskiy	+56	08.0	-101	29.0	1	47	58.6	277	310	2 59 35.5 79 106
Chelkar	+47	50.0	- 59	37.0	1	24	04.9	274	316	
Cherepanovo	+54	14.0	- 83	22.0	1	34	46.3	275	313	2 40 27.6 80 117
Cherkessk	+44	27.0	- 42	04.0	..	..	..	..	...	...
Chernogorsk	+53	49.0	- 91	18.0	1	37	51.4	278	316	
Chikman	+54	46.8	- 81	20.0	1	34	55.6	274	311	
Chumay	+55	44.0	- 87	46.0	1	38	49.3	274	311	
Chunskiy	+56	05.0	- 99	39.0	1	46	29.5	277	311	2 57 33.1 74 102
Dambuki	+54	20.0	-127	27.0	2	15	38.8	282	300	3 34 20.3 128 129
Derzhavinsk	+51	06.0	- 66	19.0	1	27	33.9	273	313	
Digora	+43	09.0	- 44	09.0	..	..	..	..	...	...
Dolgonka	+54	08.5	- 81	02.0	1	33	52.0	275	313	2 39 13.6 23 60
Donetsk	+47	55.0	- 37	40.0	..	..	..	..	...	...
Dossor	+47	32.0	- 52	59.0	1	25	28.4	272	312	
Ekibastuz	+51	43.0	- 75	20.0	1	28	59.0	276	316	
Ekimchan	+53	04.0	-132	57.0	2	23	32.4	283	296	3 43 44.5 165 157
Emba	+48	39.0	- 58	09.0	1	25	24.4	273	313	
Fort Shevchenko	+44	30.0	- 50	15.5	..	..	..	..	...	...
Gali	+42	37.5	- 41	44.0	..	..	..	..	...	...
Georgiyevsk	+44	06.6	- 43	26.0	..	..	..	..	...	...
Golubovka	+53	08.0	- 74	06.0	1	30	51.1	273	312	
Gonokhovo	+52	57.0	- 81	17.0	1	32	11.2	276	316	
Gorki	+56	15.0	- 44	05.0	1	40	42.2	260	291	
Groznyy	+43	18.0	- 45	38.0	..	..	..	..	...	...
Gruznovka	+55	08.5	-105	12.0	1	49	56.8	279	312	
Gunikha	+54	12.0	- 84	39.0	1	35	12.1	276	314	2 41 21.1 110 147
Gur'yev	+47	06.0	- 51	55.0	1	25	19.7	272	312	
Gur'yevsk'	+54	17.0	- 85	57.0	1	35	51.3	276	314	2 42 32.5 126 162
Ilanskiy	+56	14.5	- 96	05.0	1	44	11.8	276	310	
Ilimsk	+56	46.5	-103	50.0	1	50	43.4	277	308	

LOCAL CIRCUMSTANCES

Obscuration	Maximum Eclipse			Magnitude	Sun's		Third Contact			Fourth Contact			Duration		Width of Path					
	Universal Time				Alt.	Az.	Universal Time			P	V	Universal Time				P	V			
	%	h	m				s	o	o			h	m	s				o	o	h	m	s	o	o	m	s	mi
97.3	2	20	32.6	0.975	7	71							3	19	19.8	95	141			
99.1	2	29	43.0	0.990	23	89							3	36	08.6	96	136			
99.9	2	18	24.3	0.999	3	68							3	15	29.0	93	141			
100.0	2	49	31.4	1.024	38	116	2	50	18.6	298	331		4	03	49.6	98	122	1	34.3	63
97.5	2	30	51.1	0.976	23	90							3	37	20.8	97	136			
99.3	2	40	18.1	0.991	34	105							3	52	34.6	96	127			
98.3	2	16	45.5	0.984	1	66							3	12	59.0	92	141			
100.0	2	38	05.0	1.022	32	102	2	38	30.5	220	259		3	49	13.0	96	129	0	51.1	59
100.0	2	43	41.4	1.023	35	109	2	44	26.9	258	294		3	56	34.4	97	126	1	31.0	62
100.0	2	22	50.0	1.018	15	80	2	23	19.7	294	338		3	25	36.7	94	139	0	59.4	50
99.5	2	41	43.7	0.993	33	106							3	53	17.5	98	128			
100.0	2	32	36.6	1.021	26	94	2	32	52.3	342	22		3	40	50.6	96	134	0	31.4	57
100.0	2	56	18.2	1.024	42	125	2	57	07.7	300	329		4	12	09.6	99	117	1	39.1	64
96.1	2	40	17.0	0.964	35	106							3	53	20.4	94	126			
99.6	2	36	50.9	0.994	31	101							3	47	44.4	95	130			
100.0	2	53	58.0	1.024	41	122	2	54	18.8	344	14		4	09	07.5	99	119	0	41.5	64
100.0	3	00	24.7	1.025	44	131	3	01	12.7	248	275		4	17	21.8	99	113	1	35.9	65
100.0	2	53	16.1	1.024	40	121	2	53	47.9	330	0		4	08	19.1	99	120	1	03.6	64
100.0	3	00	54.5	1.025	44	131	3	01	36.2	319	346		4	17	30.8	100	113	1	23.4	65
100.0	2	36	36.1	1.022	30	100	2	37	17.6	292	330		3	46	45.8	96	131	1	23.1	59
100.0	3	00	27.7	1.025	44	131	3	01	19.9	297	324		4	17	06.8	100	114	1	44.4	65
99.4	2	22	07.6	0.992	16	80							3	25	13.3	93	138			
100.0	2	41	12.0	1.023	33	106	2	41	56.4	292	328		3	53	03.4	97	128	1	28.8	61
96.8	2	19	41.2	0.971	3	67							3	16	22.5	95	142			
97.6	2	47	19.3	0.976	39	114							4	02	13.3	96	122			
98.7	2	40	32.6	0.986	32	104							3	51	26.8	98	129			
98.8	2	46	35.8	0.987	36	112							3	59	27.2	99	125			
100.0	2	58	22.7	1.025	43	128	2	59	12.3	302	330		4	14	37.6	100	115	1	39.2	65
100.0	3	35	17.3	1.027	54	180	3	36	14.3	257	258		4	54	20.4	103	85	1	54.0	69
99.6	2	28	02.4	0.994	21	87							3	33	43.5	96	136			
99.9	2	17	38.3	0.998	3	68							3	14	50.7	93	141			
100.0	2	39	27.1	1.022	32	103	2	39	40.5	348	25		3	50	26.7	97	129	0	26.9	60
83.8	2	25	01.4	0.869	2	65							3	20	24.6	101	144			
98.5	2	21	32.3	0.985	11	75							3	22	08.8	95	140			
99.1	2	32	35.6	0.989	28	95							3	41	51.8	94	132			
100.0	3	44	15.0	1.027	55	192	3	44	45.5	223	215		5	02	56.9	104	79	1	01.0	69
99.8	2	23	06.2	0.996	15	79							3	25	39.9	95	139			
98.3	2	17	58.1	0.983	8	72							3	17	21.4	92	140			
100.0	2	17	46.7	1.014	1	66	2	18	08.0	258	303		3	14	10.0	93	142	0	42.6	39
99.0	2	18	54.8	0.989	3	68							3	16	00.3	94	142			
99.3	2	34	00.8	0.991	27	95							3	42	32.2	97	133			
99.3	2	37	57.4	0.991	32	102							3	49	22.9	95	129			
69.5	2	34	12.1	0.755	10	72							3	30	54.3	109	145			
99.2	2	17	25.7	0.990	4	69							3	15	07.6	92	141			
98.9	3	04	05.0	0.987	47	136							4	22	08.9	99	109			
100.0	2	42	06.6	1.023	34	107	2	42	52.1	262	298		3	54	27.6	97	127	1	31.0	61
98.7	2	21	02.6	0.987	10	74							3	21	14.8	95	140			
100.0	2	43	14.0	1.023	35	109	2	43	55.6	247	282		3	56	02.2	97	126	1	23.1	61
99.8	2	54	47.6	0.996	41	123							4	10	00.2	100	119			
99.5	3	03	40.7	0.993	45	135							4	20	23.6	101	112			

LOCAL CIRCUMSTANCES

Geographic Locations	Latitude		Longitude	First Contact			Second Contact								
	Universal Time			P	V	Universal Time		P	V						
	°	'	°	'	h	m	s	°	'	°	'	°	'	°	'
U.S.S.R. (Continued)															
Irbeyskoye	+55	38.4	- 95	27.0	1	42	56.1	277	312	2	52	38.0	93	123	
Irtysk	+53	20.0	- 75	27.0	1	31	21.2	274	313						
Iskitim	+54	38.0	- 83	18.0	1	35	20.8	275	312						
Kachiry	+53	04.0	- 76	06.0	1	31	04.2	274	313	2	34	26.9	50	90	
Kalkaman	+51	57.2	- 76	01.0	1	29	26.4	276	316						
Kamen-Na-Obi	+53	48.0	- 81	20.0	1	33	26.8	275	314	2	38	25.5	91	128	
Kansk	+56	12.0	- 95	43.0	1	43	53.9	276	310						
Karabutak	+49	57.0	- 60	07.0	1	26	41.7	272	312						
Karachayevsk	+43	47.0	- 41	54.6	..	..	..	..	..						
Karaganda	+49	52.0	- 73	08.0	1	26	07.9	277	319						
Karasuk	+53	44.0	- 78	03.0	1	32	27.8	274	313						
Karazhar	+47	50.5	- 56	12.0	1	24	53.0	273	314	2	21	39.8	33	77	
Kardonikskaya	+43	52.0	- 41	43.0	..	..	..	..	..						
Karton	+46	26.3	- 53	30.0	1	24	01.5	274	315	2	19	42.5	128	173	
Kaspiyskiy	+45	24.0	- 47	21.8	..	..	..	..	..						
Katangli	+51	43.0	-143	15.0	2	40	05.6	283	281						
Kayasula	+44	19.0	- 44	59.0	..	..	..	..	..						
Kazachinskoye	+56	16.0	-107	33.0	1	53	25.1	278	309	3	06	51.7	79	101	
Kemerovo	+55	20.0	- 86	05.0	1	37	28.8	275	311						
Ketoy Island	+47	20.0	-152	30.0	2	59	01.2	286	266	4	17	58.3	115	78	
Khoe	+51	19.5	-142	10.0	2	38	34.5	284	284	3	58	28.6	87	65	
Khrebtovaya	+56	42.5	-104	15.0	1	50	59.5	277	308						
Khudoyelanskaya	+54	43.0	- 99	37.0	1	44	41.3	279	314						
Kiev	+50	05.0	- 30	40.0	..	..	..	..	..						
Kiprino	+53	31.5	- 82	04.0	1	33	16.5	276	315	2	38	51.0	150	187	
Kirza	+54	15.0	- 81	40.0	1	34	13.4	275	313	2	39	46.9	25	62	
Kiselevsk	+53	58.0	- 86	40.0	1	35	42.4	276	315						
Kislovodsk	+43	54.0	- 42	54.0	..	..	..	..	..						
Kiyevka	+50	16.0	- 71	34.0	1	26	30.4	276	318						
Kizylar	+43	51.0	- 46	42.0	..	..	..	..	..						
Klyuchi	+52	14.5	- 79	12.0	1	30	34.1	276	317						
Klyuchi-Bulak	+55	31.5	-101	41.0	1	47	21.7	278	312	2	59	57.9	176	204	
Kobuleti	+41	49.0	- 41	47.0	..	..	..	..	..						
Kochki	+54	20.0	- 80	30.0	1	33	59.9	274	312						
Kokchetav	+53	17.0	- 69	22.0	1	30	42.2	272	310						
Komsomol'ska-Na-Amure	+50	32.0	-137	00.0	2	30	31.4	286	295						
Kornilovo	+53	31.5	- 81	04.0	1	32	57.5	275	314	2	37	55.9	121	158	
Koschagyl	+46	50.0	- 53	47.0	1	24	23.4	273	314	2	20	07.7	79	124	
Kovalevka	+53	08.5	- 77	40.0	1	31	29.9	275	314	2	35	13.5	87	125	
Krasnobrodskiy	+54	09.5	- 86	28.0	1	35	53.7	276	314	2	43	11.3	165	200	
Krasnoyarsk	+56	02.0	- 93	05.0	1	42	01.9	275	311						
Krasnoye	+54	36.5	- 85	24.0	1	36	06.4	275	313	2	42	30.6	73	109	
Krasnozerskoye	+53	59.0	- 79	14.0	1	33	07.6	274	312						
Kul'sary	+46	58.0	- 54	01.0	1	24	28.3	273	314	2	20	19.1	70	114	
Kulunda	+52	34.0	- 78	55.0	1	30	57.5	276	316						
Kuroal'dzhin	+50	35.0	- 70	00.0	1	26	50.5	275	316						
Kurylys	+48	38.5	- 60	44.5	1	24	53.0	274	315	2	22	55.5	129	173	
Kutaisi	+42	15.8	- 42	43.0	..	..	..	..	..						
Kuybyshev	+53	10.0	- 50	05.0	1	33	52.1	265	300						
Kuytun	+54	20.0	-101	30.0	1	45	44.6	280	315						

LOCAL CIRCUMSTANCES

Obscuration	Maximum Eclipse			Magnitude	Sun's		Third Contact					Fourth Contact					Duration		Width of
	Universal Time				Alt.	Az.	Universal Time			P	V	Universal Time			P	V	m	s	mi
	h	m	s				h	m	s			h	m	s					
%					°	°				°	°				°	°			
100.0	2	53	30.3	1.024	41	122	2	54	22.6	282	313	4	08	52.3	99	119	1	44.6	64
99.5	2	34	59.1	0.993	28	97						3	44	00.1	97	132			
99.9	2	41	42.0	0.998	33	106						3	53	23.5	98	128			
100.0	2	34	56.7	1.021	28	97	2	35	26.5	320	359	3	44	16.8	96	132	0	59.6	59
99.3	2	33	18.0	0.991	28	96						3	42	48.7	95	132			
100.0	2	39	10.4	1.022	32	103	2	39	55.4	280	318	3	50	23.3	97	129	1	29.9	60
99.9	2	54	22.9	0.997	41	123						4	09	30.7	99	119			
98.0	2	25	06.4	0.980	17	82						3	28	24.9	96	139			
98.4	2	18	59.4	0.985	2	67						3	15	34.0	94	142			
95.1	2	28	51.0	0.956	26	92						3	37	23.3	92	133			
99.8	2	37	00.2	0.996	30	100						3	46	57.1	97	131			
100.0	2	21	54.6	1.017	13	78	2	22	09.4	334	18	3	23	42.9	94	139	0	29.6	49
98.0	2	19	08.5	0.981	2	67						3	15	40.0	94	142			
100.0	2	20	05.9	1.016	11	75	2	20	29.3	238	283	3	20	49.6	93	140	0	46.8	46
99.2	2	19	31.1	0.990	7	71						3	18	01.2	94	141			
99.4	4	00	27.9	0.991	52	215						5	16	32.2	107	73			
99.8	2	18	45.0	0.996	4	69						3	16	21.7	94	141			
100.0	3	07	45.8	1.025	47	141	3	08	40.0	299	321	4	25	28.4	101	108	1	48.3	67
99.3	2	44	43.9	0.991	35	110						3	57	10.3	98	126			
100.0	4	18	55.4	1.025	49	237	4	19	52.6	279	241	5	32	21.5	107	63	1	54.3	68
100.0	3	59	27.1	1.026	53	214	4	00	25.6	304	282	5	16	06.2	106	72	1	57.0	69
99.7	3	04	06.5	0.995	45	136						4	20	57.1	101	111			
98.2	2	57	02.6	0.981	44	127						4	14	04.9	97	114			
72.7	..	..	..	..	..	..						3	23	09.7	107	146			
100.0	2	39	17.8	1.022	32	104	2	39	44.6	222	260	3	50	52.5	96	129	0	53.6	60
100.0	2	40	01.7	1.022	32	104	2	40	16.5	347	24	3	51	13.9	97	129	0	29.6	60
99.7	2	43	23.8	0.995	36	109						3	56	34.7	96	125			
99.0	2	18	49.6	0.989	3	67						3	15	43.6	94	142			
97.4	2	28	42.8	0.975	25	91						3	36	35.1	93	134			
99.6	2	17	49.1	0.995	5	70						3	15	56.0	92	141			
98.4	2	35	35.3	0.983	30	100						3	46	20.4	95	130			
100.0	3	00	09.5	1.025	44	131	3	00	21.2	200	228	4	17	14.3	99	113	0	23.3	65
98.7	2	16	53.8	0.986	1	66						3	13	11.2	92	141			
99.5	2	39	22.2	0.993	31	103						3	50	06.0	97	130			
95.8	2	32	13.3	0.962	24	91						3	38	49.9	98	135			
95.9	3	52	42.8	0.962	56	204						5	11	30.8	103	71			
100.0	2	38	36.6	1.022	32	103	2	39	17.3	251	289	3	49	47.9	96	129	1	21.4	59
100.0	2	20	35.7	1.017	11	75	2	21	03.7	287	332	3	21	27.4	94	140	0	56.0	48
100.0	2	35	56.0	1.022	29	99	2	36	38.5	284	323	3	45	52.6	96	131	1	25.0	59
100.0	2	43	29.0	1.023	35	109	2	43	46.8	208	244	3	56	31.4	97	126	0	35.5	61
99.7	2	51	38.3	0.995	39	119						4	06	05.0	99	121			
100.0	2	43	14.0	1.023	35	108	2	43	57.5	300	335	3	55	43.0	97	127	1	26.9	61
99.8	2	38	04.4	0.996	31	101						3	48	25.0	97	130			
100.0	2	20	45.7	1.017	12	76	2	21	12.2	297	341	3	21	42.9	94	140	0	53.1	48
99.4	2	35	52.1	0.992	30	100						3	46	26.3	95	130			
99.3	2	28	31.9	0.991	24	90						3	35	44.5	94	135			
100.0	2	23	22.3	1.018	17	81	2	23	49.1	239	282	3	26	55.7	94	138	0	53.6	51
99.0	2	17	04.7	0.989	2	67						3	13	43.0	92	141			
81.4	2	29	17.9	0.849	12	76						3	28	35.6	103	143			
96.7	2	58	54.1	0.968	45	129						4	16	38.0	97	112			

TOTAL SOLAR ECLIPSE OF 31 JULY 1981

LOCAL CIRCUMSTANCES

Geographic Locations	Latitude		Longitude		First Contact					Second Contact				
					Universal Time			P	V	Universal Time			P	V
	°	'	°	'	h	m	s	°	°	h	m	s	°	°
U.S.S.R. (Continued)														
Kvemo-Kolkhida	+43	14.8	- 40	18.0	..	..	..	..	..					
Kvitok	+56	05.0	- 98	28.0	1	45	37.2	277	311	2	56	21.4	64	93
Lanchkhuti	+42	05.0	- 42	02.0	..	..	..	..	..					
Lazarev	+52	12.0	-141	30.0	2	37	03.9	283	284					
Leningrad	+59	57.0	- 30	20.0	1	52	53.5	252	277					
Leninsk-Kuznetskiy	+54	40.0	- 86	10.0	1	36	30.8	275	313	2	43	08.9	80	116
Len'ki	+52	56.5	- 80	26.0	1	31	55.0	276	315					
Leonovo	+55	34.0	-101	30.0	1	47	15.8	278	312				159	187
Lesogorsk	+56	03.0	- 99	30.0	1	46	20.1	277	311	2	57	20.2	77	105
Listvyanka	+54	09.0	- 83	42.5	1	34	46.3	275	314	2	40	33.8	98	134
L'vovka	+53	15.0	- 76	30.0	1	31	25.0	274	313	2	35	09.8	27	66
Makarakskiy	+55	31.5	- 88	08.0	1	38	40.4	275	311					
Makharadze	+41	55.0	- 42	00.0	..	..	..	..	..					
Malovskiy	+54	23.5	-113	33.0	1	57	48.4	281	312					
Mariinskoye	+51	43.0	-140	12.0	2	35	13.1	284	287	3	55	09.6	106	88
Maslyanino	+54	20.0	- 84	12.0	1	35	13.6	275	313	2	41	11.3	85	121
Maykain	+51	28.0	- 75	48.0	1	28	42.8	276	317					
Mel'nikov	+52	12.5	- 81	13.0	1	31	06.6	277	317					
Mezhdurechensk	+53	41.0	- 88	06.0	1	35	58.3	277	316					
Mikha Tskhakaya	+42	16.0	- 42	04.0	..	..	..	..	..					
Mineral'nyye Vody	+44	14.0	- 43	08.0	..	..	..	..	..					
Mogocha	+53	44.0	-119	46.0	2	04	57.4	283	309					
Mogoyto	+54	22.5	-110	27.0	1	54	21.4	281	313					
Moscow	+55	45.0	- 37	37.0	1	42	59.7	258	288					
Mozdok	+43	44.5	- 44	39.0	..	..	..	..	..	2	17	46.9	88	133
Nadterechnaya	+43	37.0	- 45	20.0	..	..	..	..	..	2	17	48.2	175	220
Nal'chik	+43	29.0	- 43	37.0	..	..	..	..	..	2	17	48.2	70	115
Naurskaya	+43	39.0	- 45	19.0	..	..	..	..	..	2	17	42.5	154	199
Nazarovo	+56	01.0	- 90	23.0	1	40	31.2	275	310					
Never	+53	59.0	-124	08.0	2	10	55.2	282	305					
Nevinnomyssk	+44	38.0	- 41	55.0	..	..	..	..	..					
Nikolayevsk-Na-Amure	+53	08.0	-140	44.0	2	35	28.8	282	284					
Nizhneudinsk	+54	54.0	- 99	02.0	1	44	28.3	278	314					
Nizhniy Ingash	+56	12.0	- 96	30.0	1	44	24.8	276	310					
Nizhnaya Poyma	+56	10.0	- 97	12.0	1	44	50.6	276	311	2	55	30.1	31	60
Novoalekseyevka	+52	48.0	- 74	54.0	1	30	28.4	274	313	2	33	25.5	52	92
Novoaltaysk	+53	25.0	- 83	56.0	1	33	46.9	276	315					
Novoivanovka	+52	57.0	- 74	35.5	1	30	38.9	274	313					
Novokuznetsk	+53	45.0	- 87	08.0	1	35	36.4	277	315					
Novopesterevo	+54	26.0	- 85	45.0	1	35	59.5	276	313	2	42	29.2	102	138
Novoromanovka	+53	06.0	- 83	22.0	1	33	06.8	277	316					
Novosibirsk	+55	00.0	- 82	55.0	1	35	46.3	274	311					
Novotroitskoye	+52	40.0	- 80	10.0	1	31	26.5	276	316					
Novoyarki	+53	36.0	- 80	52.0	1	33	00.5	275	314	2	37	50.8	106	144
Ochamchira	+42	42.2	- 41	28.0	..	..	..	..	..	2	17	35.9	76	122
Ogodzha	+52	46.0	-132	33.0	2	22	56.7	284	297					
Oktyabr'skiy	+56	07.0	- 99	15.0	1	46	14.3	277	311	2	57	12.5	66	94
Ordzhonikidze	+43	03.0	- 44	41.0	..	..	..	..	..					
Osakarovka	+50	34.0	- 72	34.6	1	27	00.5	276	317					
Osinniki	+53	38.0	- 87	20.0	1	35	32.0	277	316					

LOCAL CIRCUMSTANCES

Obscuration	Maximum Eclipse			Sun's		Third Contact			Fourth Contact			Duration		Width of Path			
	Universal Time	Magnitude	Alt.			Az.	Universal Time	P	V	Universal Time	P				V		
	%			h	m		s	o	o	h	m	s	o		o	m	s	mi
98.4	2	18	55.4	0.984	1	66					3	14	56.9	94	142		
100.0	2	57	06.1	1.025	42	126	2	57	50.8	312	340	4	13	02.9	99	116	1 29.4 65
99.1	2	17	05.9	0.990	1	66						3	13	30.2	92	141	
99.5	3	57	28.2	0.992	53	211						5	13	58.4	107	74	
53.0	2	42	13.0	0.619	6	63						3	33	44.6	118	148	
100.0	2	43	54.8	1.023	35	109	2	44	40.7	292	328	3	56	39.1	97	126	1 31.8 62
99.6	2	37	22.3	0.994	31	101						3	48	27.8	95	129	
100.0	2	59	59.0	1.025	44	130	3	00	26.0	217	244	4	16	59.8	99	113	0 54.0 65
100.0	2	58	11.0	1.025	43	128	2	59	01.8	299	327	4	14	24.9	99	115	1 41.6 65
100.0	2	41	20.2	1.023	34	106	2	42	06.5	274	311	3	53	21.0	97	128	1 32.7 61
100.0	2	35	25.6	1.021	29	98	2	35	41.5	343	22	3	44	52.9	96	132	0 31.7 59
99.5	2	46	37.8	0.993	36	112						3	59	42.4	99	125	
98.7	2	16	55.9	0.987	1	66						3	13	18.1	92	141	
96.9	3	14	52.0	0.970	51	150						4	34	32.2	99	99	
100.0	3	56	11.9	1.026	54	209	3	57	14.2	284	265	5	13	23.6	106	73	2 04.6 69
100.0	2	41	57.0	1.023	34	107	2	42	42.7	288	324	3	54	05.2	97	127	1 31.4 61
98.1	2	32	29.2	0.981	28	96						3	41	59.0	94	132	
97.2	2	36	52.9	0.973	32	102						3	48	27.1	94	129	
98.4	2	44	14.4	0.983	37	110						3	58	03.0	96	124	
99.6	2	17	17.1	0.994	1	66						3	13	43.6	92	141	
98.4	2	19	08.2	0.984	3	68						3	16	08.7	94	142	
96.3	3	23	54.6	0.965	54	162						4	44	07.9	100	91	
96.5	3	10	31.2	0.967	50	144						4	29	54.2	99	102	
65.9	2	34	44.4	0.726	7	67						3	29	22.0	111	146	
100.0	2	18	10.4	1.014	4	68	2	18	34.0	278	324	3	15	36.9	93	141	0 47.1 41
100.0	2	17	51.7	1.014	4	69	2	17	55.1	191	237	3	15	30.4	93	141	0 06.9 39
100.0	2	18	09.5	1.014	3	68	2	18	30.8	296	341	3	15	14.3	93	141	0 42.6 41
100.0	2	17	54.2	1.014	4	69	2	18	05.9	212	258	3	15	32.8	93	141	0 23.4 40
99.0	2	49	10.0	0.988	38	116						4	02	45.8	99	123	
98.7	3	30	28.0	0.985	54	172						4	50	12.4	102	87	
96.2	2	19	56.3	0.966	3	67						3	16	35.6	95	142	
97.6	3	55	20.6	0.976	52	209						5	11	39.2	107	77	
98.9	2	56	33.6	0.987	43	126						4	13	20.5	98	115	
99.9	2	55	10.3	0.998	41	124						4	10	31.3	100	118	
100.0	2	55	51.3	1.024	42	125	2	56	12.5	344	13	4	11	25.0	100	118	0 42.4 64
100.0	2	33	55.7	1.021	28	96	2	34	26.0	318	357	3	42	50.3	96	133	1 00.5 58
99.3	2	40	30.4	0.991	34	105						3	52	50.3	96	127	
99.9	2	33	59.4	0.998	27	96						3	42	44.8	96	133	
98.9	2	43	30.1	0.988	36	109						3	56	55.9	96	125	
100.0	2	43	16.5	1.023	35	108	2	44	03.8	270	306	3	55	56.9	97	126	1 34.6 61
98.7	2	39	39.2	0.986	33	105						3	51	51.3	95	128	
98.9	2	41	55.9	0.987	33	106						3	53	20.9	98	128	
99.1	2	36	48.7	0.989	31	101						3	47	51.6	95	130	
100.0	2	38	34.9	1.022	32	102	2	39	19.0	265	303	3	49	40.2	96	129	1 28.2 59
100.0	2	17	56.9	1.014	1	66	2	18	18.0	289	335	3	14	16.0	93	142	0 42.1 40
99.4	3	43	52.7	0.991	55	192						5	02	50.9	103	78	
100.0	2	57	58.5	1.025	43	128	2	58	44.5	310	338	4	14	06.2	100	116	1 32.0 65
99.3	2	17	23.0	0.992	4	68						3	14	44.8	92	141	
97.6	2	29	35.3	0.976	26	92						3	37	51.3	93	133	
98.5	2	43	31.1	0.984	36	109						3	57	03.8	96	125	

LOCAL CIRCUMSTANCES

Geographic Locations	Latitude		Longitude		First Contact			Second Contact						
					Universal Time	P	V	Universal Time	P	V				
	h	m	s	°							'	h	m	s
	°	'	°	'										
U.S.S.R. (Continued)														
Ostrov Tyuleniy	+44	28.0	- 47	30.0	..	..	..	..	..	..	2 18	02.9	131	176
Pankrushikha	+53	50.0	- 80	20.0	1	33	11.9	275	313		2 37	56.5	62	100
Pavlodar	+52	16.0	- 76	57.0	1	30	04.3	276	316					
Pavlovka	+51	24.5	- 72	38.5	1	28	10.8	275	316					
Pokosnoye	+55	31.5	-101	03.0	1	46	50.9	278	312		2 59	04.4	166	193
Poltavskiy	+51	06.0	- 69	46.0	1	27	32.9	274	315		2 28	37.7	124	165
Popysayevo	+54	35.0	- 86	15.0	1	36	25.5	276	313		2 43	04.5	92	128
Poronaysk	+49	14.0	-143	07.0	2	41	30.0	287	285					
Porozhskiy	+56	05.0	-101	40.0	1	48	03.5	277	310		2 59	43.4	87	113
Posevnaya	+54	18.0	- 83	20.0	1	34	51.5	275	313		2 40	34.4	70	107
Poti	+42	09.0	- 41	40.4	..	..	..	..	..					
Prokhladnyy	+43	45.0	- 44	03.0	..	..	..	..	..		2 18	04.8	45	90
Prokop'yevsk	+53	43.0	- 86	45.0	1	35	23.0	277	315					
Promyshlennaya	+54	45.0	- 85	39.0	1	36	25.3	275	313		2 42	59.9	58	93
Pyatigorsk	+44	01.5	- 43	03.5	..	..	..	..	..					
Rasshua Island	+47	47.0	-153	02.0	2	59	21.9	286	265					
Reshety	+54	13.5	- 80	12.0	1	33	45.1	274	312					
Rodino	+52	30.0	- 80	12.0	1	31	12.8	276	316					
Rozhdestvenka	+52	40.0	- 77	30.0	1	30	46.0	275	315		2 34	46.1	152	192
Salair	+54	14.0	- 85	48.0	1	35	43.1	276	314		2 42	23.2	130	166
Samtredia	+42	09.8	- 42	22.0	..	..	..	..	..					
Saran'	+49	48.0	- 72	52.0	1	26	00.7	277	319					
Sartugay	+48	43.0	- 60	17.5	1	25	03.5	274	315		2 22	52.4	97	141
Sary-Tyuz	+43	53.5	- 41	43.0	..	..	..	..	..					
Sharchino	+53	08.5	- 81	45.0	1	32	36.8	276	315					
Shcherbakty	+52	30.0	- 78	10.0	1	30	40.6	276	316					
Shelabolikha	+53	25.0	- 82	37.0	1	33	18.2	276	315					
Shestakovo	+56	29.0	-103	58.0	1	50	28.1	277	309		3 03	10.6	36	61
Shiderty	+51	43.0	- 74	41.0	1	28	52.7	275	316					
Shira	+54	29.0	- 89	57.0	1	38	02.9	277	314					
Shirokovo	+55	26.0	- 39	24.0	1	45	26.6	278	312		2 57	10.9	169	197
Shitkino	+56	22.0	- 98	15.0	1	45	51.2	276	310					
Shortandy	+51	42.0	- 71	00.0	1	28	27.3	274	314		2 29	54.2	83	123
Skovorodino	+53	59.0	-123	56.0	2	10	38.8	282	305					
Slavgorod	+53	00.0	- 78	38.0	1	31	31.0	275	314		2 35	43.3	131	170
Smirnykh	+49	45.0	-142	50.0	2	40	39.1	286	284					
Sofiysk	+51	34.0	-139	52.0	2	34	44.9	284	288		3 54	58.1	133	115
Sorokino	+53	45.0	- 84	55.0	1	34	38.9	276	315					
Sovetskoye	+43	28.0	- 44	35.0	..	..	..	..	..		2 17	35.4	136	181
Stavropol	+45	02.5	- 42	00.0	..	..	..	..	..					
Sukhumi	+43	00.0	- 41	00.0	..	..	..	..	..					
Suzun	+53	47.0	- 82	19.0	1	33	44.3	275	314		2 39	06.7	115	153
Tal'menka	+53	49.0	- 83	35.0	1	34	14.0	276	314		2 40	15.2	142	179
Tanguy	+55	23.0	-101	02.0	1	46	39.3	278	312					
Tashkent	+41	23.0	- 69	04.0	1	16	33.6	287	336					
Tayshet	+55	56.0	- 98	00.0	1	45	04.9	277	311		2 55	36.1	80	109
Temir	+49	08.5	- 57	08.0	1	26	16.3	272	312					
Temirtau	+50	03.5	- 72	58.0	1	26	22.0	277	319					
Tinskoy	+56	09.0	- 96	55.0	1	44	37.6	276	311		2 55	12.6	30	59
Tisul'	+55	46.0	- 88	19.0	1	39	07.5	275	311					

LOCAL CIRCUMSTANCES

Obscuration	Maximum Eclipse			Magnitude	Sun's		Third Contact			Fourth Contact			Duration		Width of Path				
	Universal Time				Alt.	Az.	Universal Time			P	V	Universal Time				P	V		
	%	h	m				s	o	o			h	m	s				o	o
100.0	2	18	22.7	1.015	6	70	2	18	42.5	235	280	3	16	50.0	93	141	0	39.6	42
100.0	2	38	33.5	1.022	31	102	2	39	10.5	309	347	3	49	22.4	97	130	1	14.0	59
99.6	2	34	16.1	0.994	29	97						3	44	06.3	95	131			
99.8	2	30	49.6	0.996	26	93						3	39	02.3	95	134			
100.0	2	59	25.7	1.025	44	130	2	59	47.1	211	238	4	16	21.6	99	114	0	42.7	65
100.0	2	29	11.2	1.020	24	90	2	29	44.6	245	287	3	36	15.6	95	135	1	06.9	55
100.0	2	43	52.2	1.023	35	109	2	44	39.9	280	316	3	56	40.3	97	126	1	35.4	62
97.4	4	03	28.4	0.974	54	218						5	20	32.1	104	66			
100.0	3	00	37.6	1.025	44	131	3	01	31.7	290	317	4	17	21.1	100	113	1	48.3	65
100.0	2	41	16.0	1.023	33	106	2	41	57.6	302	338	3	53	05.3	97	128	1	23.2	61
99.6	2	17	17.2	0.995	1	66						3	13	35.6	92	141			
100.0	2	18	20.4	1.014	4	68	2	18	36.0	321	6	3	15	35.3	93	141	0	31.2	42
99.0	2	43	38.3	0.988	36	109						3	56	26.3	96	125			
100.0	2	43	37.0	1.023	35	109	2	44	14.1	315	350	3	56	08.2	98	126	1	14.2	62
98.9	2	18	55.3	0.988	3	67						3	15	53.2	94	142			
99.9	4	18	50.5	0.999	48	238						5	31	56.5	108	64			
99.6	2	39	01.4	0.994	31	102						3	49	40.3	97	130			
98.6	2	36	35.9	0.985	31	101						3	47	41.9	95	130			
100.0	2	35	09.4	1.022	29	98	2	35	32.8	218	258	3	45	08.3	95	131	0	46.7	59
100.0	2	43	32.9	1.023	35	108	2	43	42.5	243	278	3	55	48.8	97	126	1	19.3	61
99.1	2	17	04.7	0.990	2	67						3	13	35.8	92	141			
95.1	2	28	37.8	0.956	26	92						3	37	03.6	92	133			
100.0	2	23	24.9	1.018	17	81	2	23	57.4	270	314	3	26	47.9	94	138	1	05.0	51
98.0	2	19	10.1	0.981	2	67						3	15	41.8	95	142			
99.6	2	38	32.7	0.994	32	103						3	50	06.2	96	129			
99.6	2	35	18.9	0.994	30	99						3	45	35.9	95	131			
99.8	2	39	32.3	0.997	33	104						3	51	21.6	96	128			
100.0	3	03	36.3	1.025	45	135	3	04	02.0	341	6	4	20	32.9	101	111	0	51.4	66
99.4	2	32	15.4	0.992	27	95						3	41	15.7	95	133			
99.9	2	46	53.1	0.997	38	113						4	01	02.7	97	123			
100.0	2	57	29.0	1.025	43	127	2	57	47.1	207	236	4	14	03.5	99	115	0	36.2	65
99.9	2	57	09.2	0.997	42	126						4	12	52.3	100	117			
100.0	2	30	32.3	1.020	25	91	2	31	10.5	287	328	3	38	02.9	95	134	1	16.3	56
98.6	3	30	09.9	0.984	54	172						4	49	55.6	102	87			
100.0	2	36	18.5	1.022	30	100	2	36	53.7	239	278	3	46	40.1	96	131	1	10.4	59
98.6	4	02	23.2	0.984	54	217						5	19	23.5	105	68			
100.0	3	55	53.3	1.027	54	209	3	56	48.5	257	238	5	13	16.2	105	73	1	50.4	69
99.8	2	41	42.6	0.996	34	107						3	54	18.7	96	127			
100.0	2	17	52.7	1.014	4	68	2	18	10.1	230	276	3	15	15.9	93	141	0	34.7	40
95.2	2	20	22.6	0.959	3	67						3	17	05.3	96	142			
99.6	2	18	25.3	0.994	1	66						3	14	38.0	94	142			
100.0	2	39	49.8	1.022	33	104	2	40	32.9	256	294	3	51	25.7	96	129	1	26.2	60
100.0	2	40	47.4	1.023	33	105	2	41	19.6	230	267	3	52	51.8	96	128	1	04.4	60
99.9	2	59	17.0	0.997	44	129						4	16	17.8	99	113			
71.6	2	15	41.1	0.771	20	83						3	21	00.8	80	132			
100.0	2	56	27.3	1.025	42	126	2	57	18.5	295	324	4	12	22.1	99	117	1	42.4	64
97.8	2	23	42.4	0.978	15	79						3	25	53.2	96	139			
95.8	2	29	02.6	0.962	26	92						3	37	30.2	92	133			
100.0	2	55	32.7	1.024	41	124	2	55	52.8	345	15	4	11	02.4	99	118	0	40.2	64
99.0	2	47	05.5	0.988	36	113						4	00	07.2	99	125			

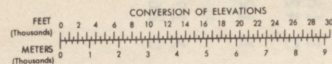
LOCAL CIRCUMSTANCES

Geographic Locations	Latitude		Longitude		First Contact			Second Contact		
					Universal Time			Universal Time		
	°	'	°	'	h	m	s	P	V	
U.S.S.R. (Continued)										
Tkibuli	+42	11.0	- 43	00.0	..	..	..	...	...	
Toguchin	+55	15.0	- 84	24.0	1	36	41.2	274	311	
Tokur	+53	08.0	-132	54.0	2	23	27.8	283	296	3 43 27.1 154 147
Topki	+55	17.0	- 85	36.0	1	37	12.3	274	311	
Tselinograd	+51	10.0	- 71	25.0	1	27	43.9	275	316	
Tsentral'nyy	+55	13.0	- 87	39.0	1	37	59.3	275	312	
Tsimmermanovka	+51	20.0	-139	14.0	2	33	49.9	285	289	
Tsulu Kidze	+42	19.4	- 42	25.4	..	..	..	...	...	
Tulun	+54	35.0	-100	34.0	1	45	16.6	279	315	
Turgay	+49	37.3	- 63	30.0	1	25	46.1	274	315	2 24 39.1 99 142
Turgay	+51	46.0	- 72	45.0	1	28	41.9	275	315	2 30 50.9 130 171
Tymovskoye	+50	50.0	-142	40.0	2	39	40.3	285	283	3 59 46.7 122 100
Tyumentsevo	+53	20.0	- 81	30.0	1	32	48.7	276	315	
Uakit	+55	29.7	-113	37.5	1	58	51.2	280	308	3 15 00.7 173 190
Uruk	+43	18.0	- 44	02.0	..	..	..	...	...	2 17 32.0 131 176
Uspenka	+52	54.5	- 77	25.0	1	31	06.0	275	314	2 34 45.8 110 149
Ust'-Kut	+56	48.0	-105	45.0	1	52	24.4	277	308	
Ustyuzhanino	+54	11.5	- 81	20.0	1	34	01.9	275	313	2 39 28.7 25 62
Uyar	+55	48.5	- 94	19.0	1	42	27.1	276	311	2 51 54.7 56 87
Uzhur	+55	18.0	- 89	54.0	1	39	12.4	276	312	2 47 10.6 62 95
Vani	+42	05.0	- 42	31.0	..	..	..	...	...	
Verkh-Chik	+54	39.0	- 81	55.0	1	34	54.5	274	312	
Verkhnyaya Suyetko	+53	19.0	- 80	02.0	1	32	20.9	275	314	2 36 59.0 124 162
Vikhorevka	+56	07.0	-101	11.0	1	47	43.1	277	310	2 59 14.3 80 107
Vishnevka	+50	50.3	- 72	06.0	1	27	20.0	276	317	
Volchnoburlinskoye	+54	04.0	- 80	47.0	1	33	40.7	275	313	2 38 50.2 33 70
Voznesenskaya	+43	32.5	- 44	45.0	..	..	..	...	...	2 17 36.7 131 177
Yermentau	+51	37.2	- 73	06.5	1	28	31.7	275	315	
Yessentuki	+44	05.0	- 42	51.5	..	..	..	...	...	
Yurga	+55	44.0	- 84	55.0	1	37	37.6	274	310	
Yurty	+56	03.0	- 97	37.0	1	44	58.3	276	311	2 55 27.5 61 90
Zalesovo	+54	00.0	- 84	44.0	1	34	56.4	276	314	2 41 21.3 142 178
Zaozernyy	+55	57.5	- 94	42.0	1	42	54.2	276	311	2 52 44.1 33 64
Zarb'	+55	27.0	-101	02.0	1	46	44.4	278	312	
Zarechnaya	+55	59.0	- 97	55.0	1	45	05.4	277	311	2 55 36.4 73 102
Zav'yalovo	+52	50.0	- 80	55.0	1	31	54.3	276	316	
Zelenchukskaya	+43	52.0	- 41	35.5	..	..	..	...	...	
Zeya	+53	44.0	-127	16.0	2	15	13.5	283	302	
Zhaksy	+51	54.5	- 67	19.0	1	28	40.6	273	312	
Zhaltyr	+51	37.5	- 69	50.0	1	28	17.4	274	314	2 29 30.5 51 92
Zheleznogorsk-Ilimskiy	+56	34.0	-104	08.0	1	50	42.9	277	309	
Zholymbet	+51	45.0	- 71	45.0	1	28	34.9	274	314	2 30 16.3 100 140
Zhuravlevo	+54	47.0	- 85	03.0	1	36	13.7	275	312	2 42 50.9 33 68
Zhuravlikha	+53	47.0	- 84	14.0	1	34	25.7	276	315	
Znamenka	+53	10.0	- 79	28.0	1	31	58.4	275	314	2 36 27.5 130 169
Zokladnoye	+52	35.5	- 80	59.0	1	31	34.7	276	316	
Zolotaya Gora	+54	16.5	-126	38.0	2	14	29.0	282	302	3 33 27.7 155 157
Zugdidi	+42	30.0	- 41	51.8	..	..	..	...	...	2 17 23.0 147 192

LOCAL CIRCUMSTANCES

Obscuration	Maximum Eclipse			Magnitude	Sun's		Third Contact					Fourth Contact					Duration		Width of Path	
	Universal Time				Alt.	Az.	Universal Time			P	V	Universal Time			P	V				
	%	h	m				s	°	°			h	m	s			°	°	h	m	s	°	°	m	s	mi
98.5	2	16	54.3	0.985	2	67														
98.8	2	43	20.5	0.987	34	108														
100.0	3	44	07.5	1.027	55	192	3	44	47.9	233	225	5	02	47.8	104	79	1	20.8	69	
99.2	2	44	17.4	0.990	35	109														
99.9	2	29	56.5	0.997	25	91														
99.9	2	45	50.0	0.999	36	111														
99.8	3	55	13.6	0.997	55	208														
99.4	2	17	14.0	0.993	2	67														
97.6	2	58	01.1	0.976	44	128														
100.0	2	25	13.5	1.019	19	84	2	25	47.9	268	311	3	29	51.8	94	137	1	08.8	52	
100.0	2	31	23.6	1.021	26	93	2	31	56.3	239	280	3	39	36.2	95	134	1	05.4	56	
100.0	4	00	46.0	1.026	53	215	4	01	45.2	269	246	5	17	26.0	106	71	1	58.5	69	
99.9	2	38	38.3	0.999	32	103														
100.0	3	15	19.1	1.026	50	151	3	15	37.6	208	225	4	34	14.0	101	100	0	36.9	67	
100.0	2	17	50.3	1.014	3	68	2	18	08.6	235	280	3	15	01.7	93	141	0	36.6	39	
100.0	2	35	27.2	1.022	29	98	2	36	08.6	260	299	3	45	21.0	96	131	1	22.8	59	
99.6	3	05	56.2	0.993	46	138														
100.0	2	39	43.3	1.022	32	103	2	39	57.8	347	24	3	50	49.0	97	129	0	29.1	60	
100.0	2	52	33.9	1.024	40	120	2	53	13.1	318	349	4	07	30.3	99	120	1	18.4	63	
100.0	2	47	51.3	1.023	37	114	2	48	32.0	312	345	4	01	38.2	98	123	1	21.4	63	
98.7	2	16	56.8	0.987	2	67														
99.3	2	40	45.3	0.991	32	104														
100.0	2	37	38.2	1.022	31	101	2	38	17.4	247	286	3	48	28.5	96	130	1	18.4	59	
100.0	3	00	06.5	1.025	44	130	3	00	58.7	297	324	4	16	42.2	100	114	1	44.4	65	
98.7	2	29	45.8	0.985	25	92														
100.0	2	39	10.8	1.022	32	103	2	39	31.4	338	16	3	50	06.1	97	130	0	41.2	60	
100.0	2	17	55.3	1.014	4	68	2	18	13.8	235	280	3	15	22.1	93	141	0	37.1	40	
99.9	2	31	20.9	0.998	26	93														
98.5	2	19	02.7	0.985	3	67														
97.7	2	44	22.7	0.977	34	109														
100.0	2	56	10.1	1.024	42	125	2	56	52.6	315	344	4	11	54.7	99	117	1	25.1	64	
100.0	2	41	54.2	1.023	34	107	2	42	27.2	231	267	3	54	21.2	96	127	1	05.9	61	
100.0	2	53	06.5	1.024	40	121	2	53	28.9	342	12	4	08	04.9	99	120	0	44.8	64	
99.9	2	59	20.6	0.999	44	129														
100.0	2	56	25.0	1.025	42	125	2	57	13.6	303	332	4	12	16.8	99	117	1	37.2	64	
99.1	2	37	32.6	0.990	32	102														
97.9	2	19	10.8	0.980	2	66														
99.3	3	35	17.1	0.991	55	179														
98.2	2	29	30.7	0.981	22	88														
100.0	2	29	58.3	1.020	24	90	2	30	26.0	318	359	3	37	01.0	95	135	0	55.5	55	
99.9	3	03	51.8	0.999	45	135														
100.0	2	30	55.6	1.020	25	92	2	31	34.9	270	311	3	38	44.0	95	134	1	18.6	56	
100.0	2	43	11.9	1.023	34	108	2	43	33.0	340	15	3	55	29.2	98	127	0	42.1	61	
99.9	2	41	13.9	0.999	34	106														
100.0	2	37	03.7	1.022	31	101	2	37	39.9	241	279	3	47	42.9	96	130	1	12.4	59	
98.4	2	37	15.2	0.983	32	102														
100.0	3	34	06.2	1.027	54	178	3	34	44.8	230	232	4	53	19.4	103	86	1	17.1	69	
100.0	2	17	36.1	1.014	1	66	2	17	49.1	219	265	3	14	00.8	93	141	0	26.1	40	

ELEVATIONS IN FEET



MAXIMUM TERRAIN ELEVATIONS

Maximum Terrain elevation figures centered in the area bounded by ticked lines of LATITUDE and LONGITUDE, are represented in THOUSANDS and HUNDREDS of feet, BUT DO NOT INCLUDE ELEVATIONS OF VERTICAL OBSTRUCTIONS.

3100 feet 31

ATTENTION THIS CHART CONTAINS MAXIMUM ELEVATION FIGURES (MEF)

The Maximum Elevation Figures shown in quadrangles bounded by ticked lines of latitude and longitude are represented in THOUSANDS and HUNDREDS of feet above mean sea level. The MEF is based on information available concerning the highest known feature in each quadrangle, including terrain and obstructions (trees, towers, antennas, etc.)

Example: 12,500 feet 12⁵

CULTURE

Actual city outline	Towns and villages (outline unknown)
Land mark features (unillustrated)	Dual lane roads
Primary roads	Secondary roads
Tracks and trails	Multiple track R.R.
Single track R.R.	Power transmission line

VEGETATION

To assure legibility of significant relief, vegetation patterns are shown in relatively level areas only.

Vegetation

AERONAUTICAL INFORMATION

Major aerodromes
Runway pattern and 6000 foot diameter circle is shown at 1:500,000 scale. Center of circle represents true position of airfield.
Major aerodromes, runway pattern not available
Minor aerodromes
Seaplane base
Jet facilities available

Major aerodromes portrayed have a hard surface runway length of 3000 feet or more. When runway pattern is not shown, number following the name indicates length of longest runway to nearest hundreds of feet. Aerodrome elevations are in feet above sea level.

OBSTRUCTIONS

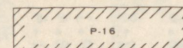
Vertical obstructions
Highest vertical obstruction (above MSL) within ticked lines of latitude and longitude
Multiple obstructions
Vertical obstructions with landmark significance

Numbers adjacent to obstruction indicate elevation of top of obstruction above mean sea level (MSL). Numerals in parentheses indicate height above ground level (AGL). Vertical obstructions under 200 feet in height (AGL) are not shown.

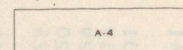
RADIO AIDS TO NAVIGATION

- ☉ VHF OMNI RANGE (VOR)
- ✈ VORTAC
- ✈ TACAN
- ✈ VOR with DME
- Other Facilities

SPECIAL USE AIRSPACE



PROHIBITED AREAS



ALERT, CAUTION, DANGER
RESTRICTED OR WARNING AREA

NUMBERS INDICATE INTERNATIONALLY
RECOGNIZED NUMERICAL
IDENTIFICATION

BUFFER ZONE

CONTOUR INTERVAL

1000 feet
Intermediate contour shown at 500 feet
Auxiliary Contour shown at 250 and 750 foot intervals
Basic Intermediate Auxiliary
Dashed contours indicate approximate relief

CONTOURS

(Accuracy based on Mean Sea Level)
Accurate to within 500 feet.

SPOT ELEVATIONS

(Accuracy based on Mean Sea Level)

Maximum Vertical error 100 feet	0.000
Maximum Vertical error 400 feet	0.000
Approximate or doubtful location	
Vertical error same as contours	0.000
Critical elevation	0.000
Lake and Stream elevation	0.000

WARNING

Aircraft infringing upon Non-Free Flying
Territory may be fired on without warning.
Consult NOTAMS and Flight Information
Publications for the latest air information.

GLOSSARY

Bukhta	bay
Ch'ih	lake
Gobi	depression
Gol	river
Gora	mountain
Guba	bay
Ho	river
Hu	lake
Khrebet	mountain range
Ling	mountain range
Nurus	mountain range
Nuur	lake
Ostrov	island
Ozero	lake
Pa	lake
Poluostrov	peninsula
Proliv	strait
Shan	mountain
Zaliv	bay

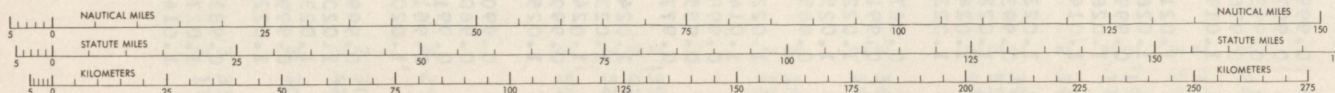
Bank	Bank, shoal
Bukhta	Bay, gulf
Burno	Point
Çay	Stream
Çayl	Stream
Dağı	Mountains
Dagları	Mountains
Deresi	Stream
Gölü	Lake
İrmağı	Stream
İrmağ	Stream
Kosa	Split, bar
Liman	Bay, lagoon
Mys	Point
Nehr	Stream
Ostroval	Island (s)
Ozerol	Lake (s)
Peski	Desert
Poluostrov	Peninsula
Proliv	Strait
Streika	Split
Tepe	Mountain
Vodokhranilishche	Reservoir
Zaliv	Bay

NOTES

This chart is not an authority for international boundaries.

Power transmission line information on this chart is incomplete.

Geographic names or their spellings do not necessarily reflect recognition of the political status of an area by the United States Government.

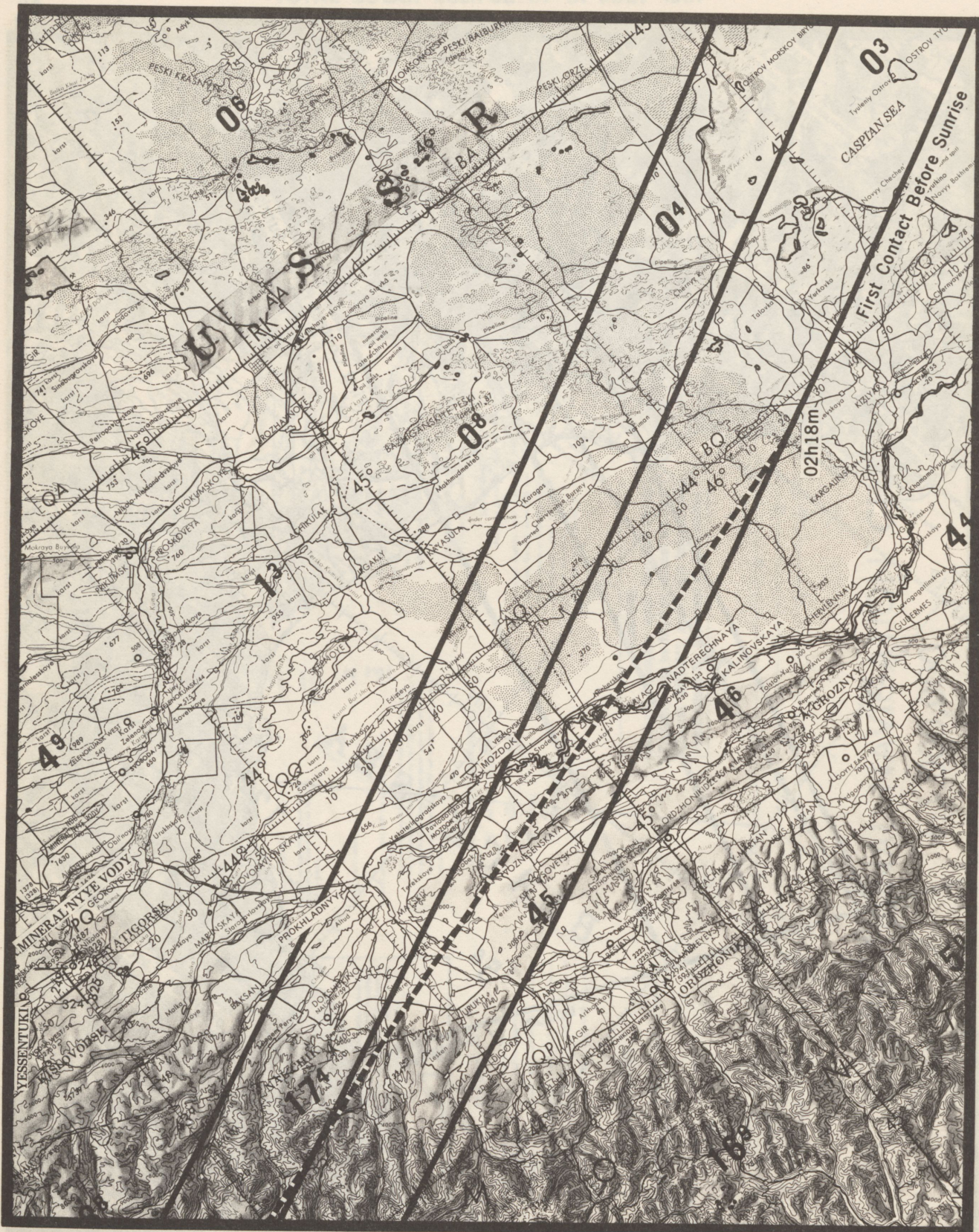


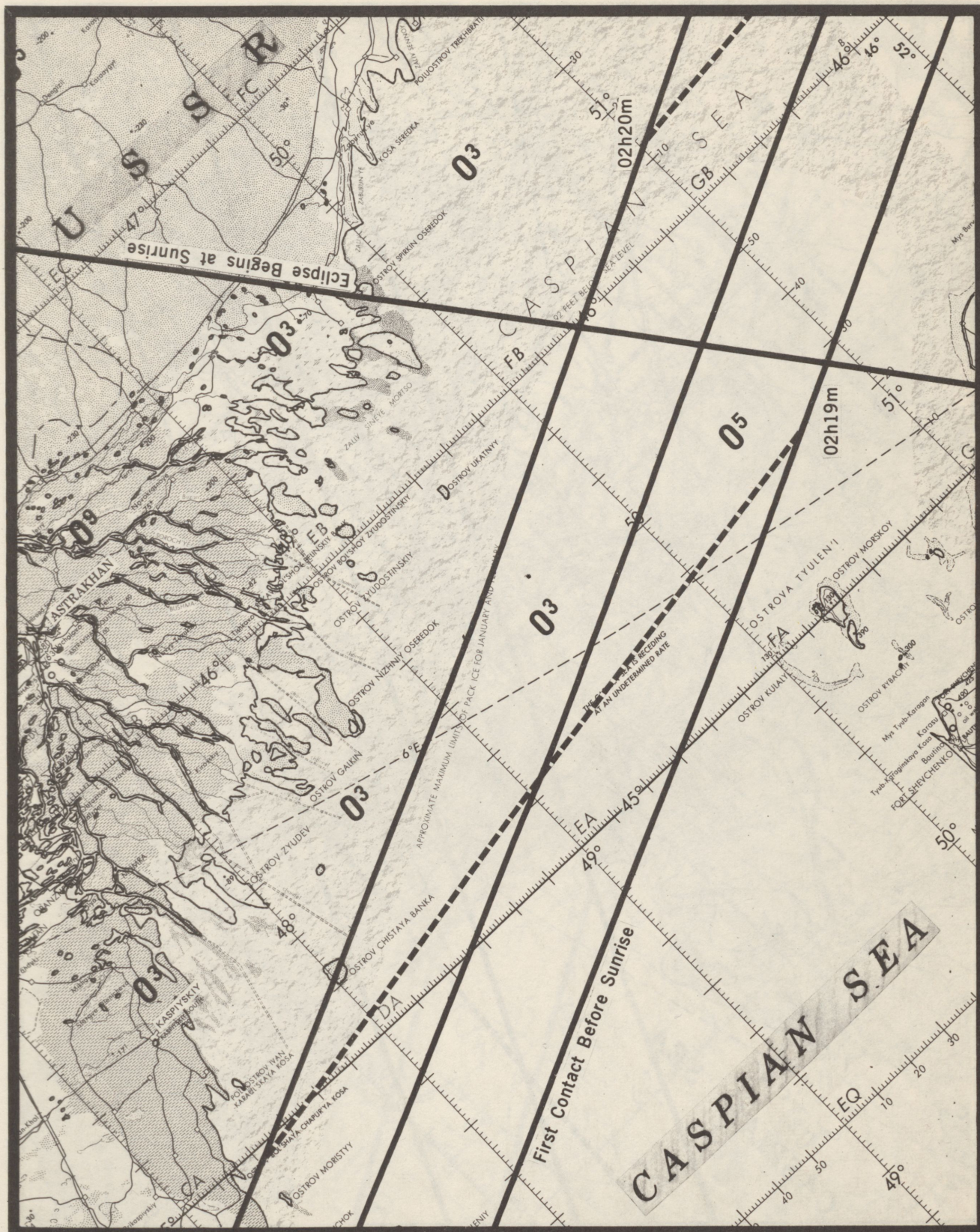
OPERATIONAL NAVIGATION CHART

1:1,000,000

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National Ocean Survey,
Riverdale, MD. 20840

























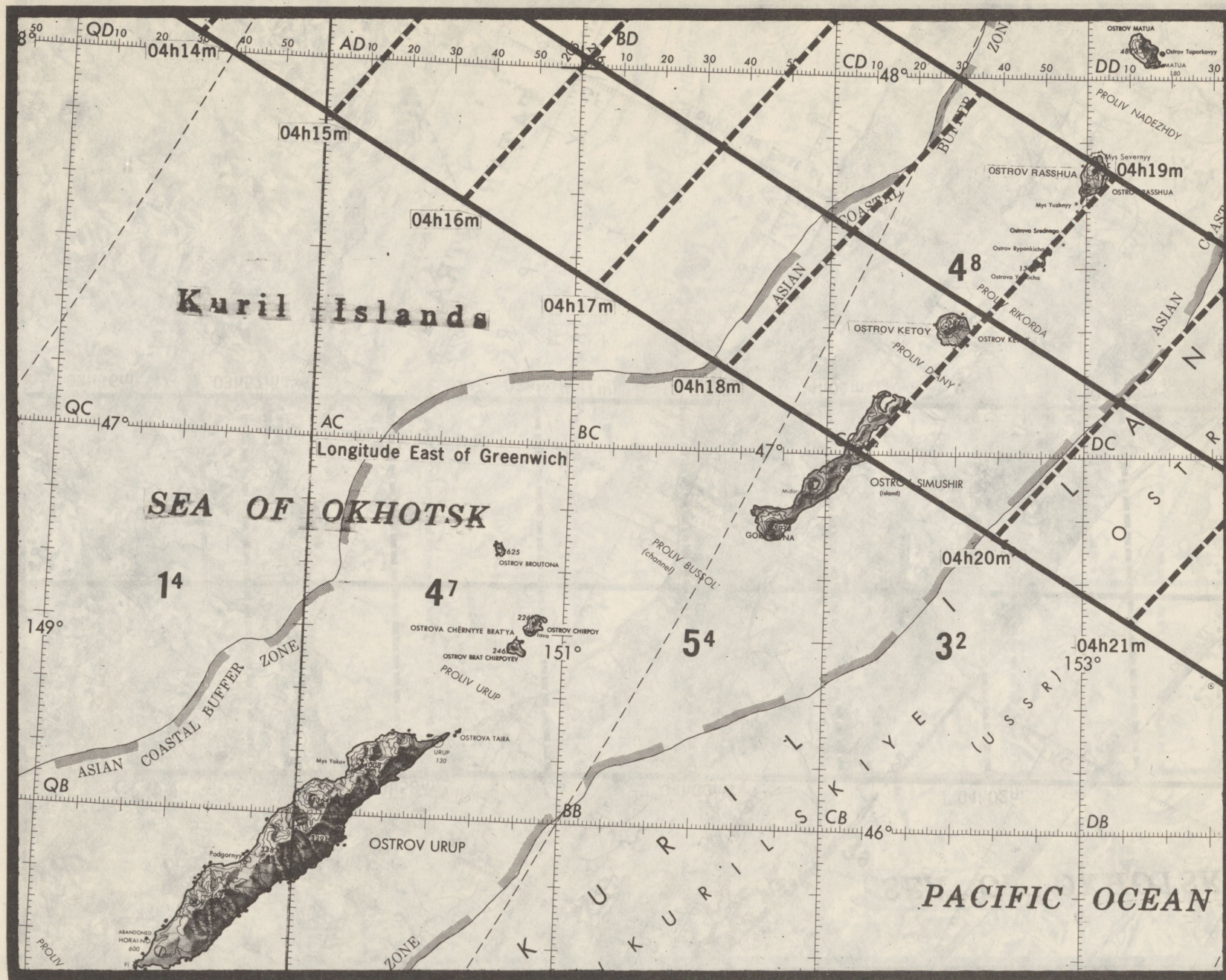












WEATHER STATISTICS

These stations, near the path, are listed in order of longitude. The first line for each station gives monthly statistics for July, the second line is for August. The key to the heading codes follows the main table.

	E. Long.	Lat.	Elev.	Wind	Temp (C)					Prec. (mm)					No. of days					Cloudiness		
					a	b	c	d	e	f	g	h	i	j	k	l	m	(Tenths)				
																		07h	13h	19h		
Degrees/Min	m.	m/s																				
Sukhumi	41 05	43 10	37	W 1.5	23.5	8.2	40	12	79	112	307	14	0.3	0.1	10.8	6	7.9	5.7	5.0	5.7		
Batumi	41 40	41 45	92	W 1.4	23.9	8.8	41	11	75	114	492	7	0.2	0.0	10.0	6	6.6	5.1	4.5	5.2		
				SW 1.4	23.2	9.5	40	13	81	233	699	54	0.5	0.6	15.3	5	11.5	6.4	6.2	6.9		
Kutaisi	42 38	42 16	116	W 3.0	22.9	9.2	40	10	71	106	463	16	2.7	0.8	13.6	7	12.4	6.3	5.7	7.1		
				W 3.4	23.4	9.4	40	10	74	86	205	2	4.3	1	11.6	5	12.1	5.5	5.1	6.4		
Pyatigorsk	43 02	44 03	573	NW 2.9	21.6		41	7	65	70			1.9	1	11.3	6	6.7	4.9	5.5	6.0		
				E 2.9	20.8		40	5	65	50			1.7	2	10.0	3	5.9	4.6	5.0	5.8		
Astrakhan	48 02	46 16	18	E 4.2	25.1	12.6	40	11	56	23	94	0	0.9	0.3	4.8	3	2.3	3.8	4.6	4.0		
				E 4.1	23.3	13.7	39	6	60	12	68	0	1.0	0.7	4.1	5	2.5	3.6	4.3	3.9		
Ft. Shevchenko	50 17	44 33	-23	N 6.4	25.8	8.7	43	13	63	15	71	0	1.0	1	4.3	2	2	3.9	3.4	3.2		
				N 7.2	24.5	9.2	43	10	60	7	85	0	1.6	1	4.4	2	3	3.5	3.2	3.0		
Gur'ev	51 51	47 01	23	W 4.8	25.4	13.4	45	8	53	20	114	0	4.8	0.1	4.3	3	4.7	3.6	4.7	4.1		
				W 4.6	23.2	14.3	45	4	52	11	99	0	3.0	0.9	3.6	2	3.5	3.2	4.3	3.7		
Turgay	63 30	49 38	123	N 4.5	24.2	13.9	43	6	46	27	116	0	1.7	0.1	5.5	5	4	3.8	5.6	4.9		
				N 4.5	21.6	14.2	42	3	48	14	69	0	2.0	0.2	4.8	2	4	3.6	4.8	4.4		
Karaganda	73 08	49 48	537	NE 3.9	20.6	15.8	39	3	55	43			3.0	1	10.8	8	4	4.8	6.7	5.4		
				NE 3.8	18.3	16.1	40	-1	55	28			2.5	1	7.5	4	3	4.6	6.1	5.1		
Omsk	73 24	54 56	105	NW 3.7	19.5	12.1	40	2	68	72	199	20	0.7	2	12.5	7	9.1	6.1	7.5	6.6		
				NW 3.6	16.5	12.1	37	-2	71	46	121	5	0.7	2	11.6	4	8.9	6.5	7.4	6.3		
Semipalatinsk	80 13	50 24	202	W 3.1	22.1	14.1	42	5	56	32	120	1	2.1	0.4	8.3	6	5	4.9	6.2	5.7		
				W 2.9	19.9	14.6	42	1	57	23	69	0	1.4	0.9	7.9	5	4	4.8	5.9	5.3		
Novosibirsk	82 54	55 02	162	N 2.9	18.7	11.4	38	2	72	74	140	11		2	15.5	10	8.7	6.2	7.2	6.6		
				SW 3.1	16.0	11.0	35	-2	76	60	128	8		4	16.2	6	11.4	7.0	7.6	6.6		
Barnaul	83 48	53 20	158	NE 2.8	19.6	11.8	38	3	68	79	187	17	1.8	2	12.5	8	6.5	6.1	7.1	6.7		
				NE 2.7	17.0	12.1	36	-1	76	52	139	2	1.1	3	12.3	6	6.8	6.1	6.9	6.2		
Kemerovo	86 04	55 23	134		18.4	12.4	38	-1	73	77				3	13.3	10	9.3	6.4	7.7	6.9		
					15.5	12.1	35	-3	77	57				6	13.8	6	10.7	7.1	7.7	6.6		
Minusinsk	91 42	53 42	251	SW 1.9	19.7	13.5	39	2	67	66	137	18	0.8	2	12.5	6	10	6.3	6.5	6.9		
				SW 2.0	16.6	13.7	38	-3	70	43	118	10	0.4	3	14.4	4	8	6.4	6.3	6.4		
Krasnoyarsk	92 53	56 00	156	SW 1.7	19.9	10.9	41	4	71	83	171	17	0.1	2	13.2	6		6.4	7.3	6.8		
				SW 1.7	16.6	10.2	37	-1	76	65	157	14	0.2	3	14.9	4		7.0	7.7	6.8		
Bratsk	101 50	56 04	326		18.3		32	2	70	55			0.0	1.4	9.1	8.1						
					15.6		30	2	74	50			0.0	3.0	8.5	4.4						
Irkutsk	104 79	52 16	468	SE 2.2	17.5	13.4	36	0	74	102	226	13	1.6	5	14.4	7	15	7.6	7.1	7.7		
				SE 2.2	15.0	12.6	34	-3	78	99	173	20	1.1	6	14.6	4	11	7.6	7.0	7.2		
Kirensk	108 07	57 46	256	NE 2.0	18.8	13.2	37	0	74	67	142	10	1.1	9	12.2	6	9	7.1	7.0	6.8		
				N 2.0	15.2	12.1	36	-5	78	56	165	2	1.0	13	14.0	4	13	8.4	7.1	6.5		
Bomnak	128 56	54 43	357	E 2.3	15.0	14.4	34	-2	67	82	182	13	0.5	1	12.4	8	14.3	7.1	7.5	7.7		
				E 2.1	18.2	12.8	35	0	75	113	406	16	0.3	3	12.9	9	14.5	7.4	7.2	7.4		
Nikolayevsk-na-Amure	140 42	53 09	46	E 3.6	19.6	9.7	34	1	80	55	208	1	1.9	2	11	2	13.8	7.5	6.9	6.6		
				E 3.3	18.0	8.9	35	1	82	72	170	6	2.2	3	13	2	13.4	7.7	7.1	6.7		
Vyakhtu	141 54	51 36	14	S 5.4	13.6		30	1	87	68			4.5	10		2	17.9	8.3	7.9	7.6		
				S 5.1	15.4		33	3	87	78			4.8	7		2	14.6	8.2	7.5	7.3		
Onor	142 35	50 14	180	SE 2.7	15.2		36	-1	81	65	174	12	0.0	16	13.4	1	17.2	8.7	7.2	7.2		
				SE 2.5	15.6		37	0	83	73	208	11	0.1	12	14.3	1	16.8	8.5	7.5	7.5		
Simushir	150 47	47 15							94	112												

Column Heading Codes

a	Mean temperature	h	Minimum precipitation, month
b	Mean daily range of temperature	i	Wind speed exceeds 15 m/s
c	Maximum temperature	j	Fog
d	Minimum temperature	k	Precipitation exceeding 0.1 mm
e	Relative humidity, per cent	l	Thunderstorm
f	Mean precipitation, month	m	Cloud cover 0.8-1.0
g	Maximum precipitation, month		

